NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

Volume I Number 6

Contents for September 30, 1948

Subject Category	Page
Absorption and Scattering of Radiation	264
Atomic Bombs	265
Atomic Power	265
Biological Effects of Radiation	266
Biology, General	271
Ceramics	273
Chemistry, Analytical	274
Chemistry, General	277
Corrosion and Anti-Corrosion	278
Cosmic Radiation	278
Crystallography	280
Fluorocarbons	281
Geophysics	281
Health Protection	282
Instruments	283
Isotopes	288
Isotopes Separation	290
Laboratories	290
Mass Spectra	291
Metallurgy	291
Mineral Resources	293
Neutrons	293
Nuclear Physics-Methods of Measuring	298
Nuclear Properties	300
Nuclear Theory	301
Nuclear Transformation	303
Particle Accelerators	307
Physics, General	309
Radiation Sickness	310
Radioactivity	311
Radiochemistry	313
Radiotherapy	314
Rare Earths	315
Spectroscopy	316
Tracer Applications	317
Tracer Applications - Radioactive	318
Transuranic Elements	321
Uranium	323
Vacuum	326

Indices follow page 326

Location List of Atomic Energy Commission Declassified Documents

Document	Abstract No.	Page
AECD-2169	1070	323
AECD-2170	909	273
AECD-2171	910	273
AECD-2172	888	265
AECD-2173	974	293
AECD-2174	975	293
AECD-2175	911	274
AECD-2176	905	271
AECD-2177	1071	323
AECD-2178	961	290
AECD-2179	1064	321
AECD-2180	913	274
AECD-2181	976	294
AECD-2182	1065	321
AECD-2183	977	294
AECD-2184	1072	324
AECD-2185	1066	322
AECD-2186	1078	326
AECD-2187	912	274
AECD-2188	946	283
AECD-2189	1006	303
AECD-2190	978	295
AECD-2191	990	298
AECD-2192	1007	303
AECD-2193	1008	304
AECD-2194	1009	304
AECD-2195	1067	322
AECD-2196	979	295
AECD-2197	991	298
AECD-2198	892	266
AECD-2199	1028	311
AECD-2200	1017	307
AECD-2201	889	265
AECD-2202	947	283
AECD-2203	992	298
AECD-2204	906	272
AECD-2205	887	265
AECD-2206	1079	326
AECD-2207	955	288
AECD-2208	948	284
AECD-2209	956	289
AECD-2210	1041	315
AECD-2211	1010	304

2-- Location List of AECD

Document	Abstract No.	Page
AECD-2212	907	272
AECD-2213	1073	324
AECD-2214	949	287
AECD-2215	908	272
AECD-2216	1074	324
AECD-2217	941	282
AECD-2218	1042	315
AECD-2219	893	267
AECD-2220	914	274
AECD-2221	957	289
AECD-2222	1011	305
AECD-2223	922	277
AECD-2224	1068	323
AECD-2225	923	277

ABSORPTION AND SCATTERING OF RADIATION

884 Angular Distribution of Alphas from $Li^6(d,\alpha)\alpha$ and $Li^7(p,\alpha)\alpha$, by N. P. Heydenburg, C. M. Hudson, D. R. Ingles, and W. D. Whitehead, Jr. Physical Review 74, p. 405-410, August 15, 1948.

The intensity of the reaction $Li^6(d,\alpha)\alpha$ is observed to vary with angle as $1 + A(E)\cos^2\theta + B(E)\cos^4\theta$, as expected from the Bose statistics of the product alphas, with A(E) rising gradually beginning just below 1 Mev to a broad maximum a little below unity at a bombarding energy E in the neighborhood of 2 Mev. The coefficient B(E) remains zero up to almost 1.5 Mev and rises to a positive value of about 0.35 at higher energies. The yield curve observed at right angles to the beam displays a sharp maximum at 0.75 Mev and there is evidence of approach to another peak at or just beyond the highest bombarding energy employed, 3.75 Mev. The substitution of a proportional counter for the ionization chamber used in earlier work has made possible improvement over earlier observations of the angular distribution of the reaction $Li^7(p,\alpha)\alpha$ in the neighborhood of 3 Mev, where difficulty was experienced in the discrimination against pile-up of scattered protons, and the new results show a node in the curve for A(E) at 2.7 Mev. A peak in the yield curve of this reaction is found at 3 Mev, which is about 3 Mev lower in the compound nucleus Be^8 than the lower peak observed in the reaction $Li^6(d,\alpha)\alpha$. There is great similarity in the trends of the angular distributions of the two reactions, but their coefficients B(E) have opposite signs in the energy regions investigated, and both A(E) and B(E) rise from zero more gradually in $Li^6(d,\alpha)\alpha$ than in $Li^7(p,\alpha)\alpha$ as the bombarding energy increases from low values.

885 Beta-Beta-Coincidence Curves for Ir^{192} and Ta^{182}, by M. V. Scherb and C. E. Mandeville, Physical Review 74, p. 508-509, August 15, 1948.

Beta-beta-coincidence rates are shown for Ir^{192} and Ta^{182} as a function of aluminum absorber thickness. The data of Wiedenbeck and Chu. Physical Review 72, 1171 (1947) were substantiated. For Ta^{182} the beta-beta-coincidence rate remains constant at 1.2×10^{-3} per beta-ray beyond 0.005 g/cm^2 of aluminum.

886 On the Anomalous Absorption of Gamma-Photons, by P. K. Sen Chaudhury. Indian Journal of Physics 22, p. 106-118, March 1948.

The absorption coefficient of RaC (Bi^{214}) gamma rays penetrating through more than 16 cm and up to 20 cm of lead was experimentally measured with a Geiger-Muller counter. The counter was placed at different distances from the source and in vertical and horizontal positions in order to investigate the nature of secondary radiations. The results obtained show that the heterogeneity of the photon beam and the secondary radiation combined has two opposite effects on the apparent absorption coefficient obtained by gradually increasing the thickness of absorber. One effect predominates over the other depending on the position of the counter. When the counter is near to the absorber surface the apparent absorption coefficient increases with increasing thickness of Pb and when further away it decreases with increasing thickness. These investigations may, therefore, have some significance in regard to Rossi transition curves for cosmic rays. When the counter is at a distance 45 cm from the source the absorption coefficient of gamma rays filtered through 19 cm Pb is $416 \pm .028$ cm^{-1} which is more than 10% less than the theoretical minimum absorption coefficient for gamma rays in Pb. It is concluded this difference may be mainly due to positron annihilation radiation. It is pointed out that since a slow positron gains in energy by capturing an electron the subsequent annihilation quanta may be partly responsible for the backward radiations in cosmic rays and for the excess of low energy Compton electron associated with a cascade.

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ABSORPTION AND SCATTERING OF RADIATION

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Another fact noticed in the last experiment is that with the source in proper position the background rate of counting, which remains nearly steady after 24.8 cm of Pb, is about double to that due to cosmic rays alone. This may be merely due to some multiple scattered quanta but the possibility of these residual radiations being partly meson-like or neutron-like is not excluded.

ATOMIC BOMBS

887 Comments on the Atomic Bomb, by A. W. Betts. AECD-2205 (LADC-530), n.d., decl. August 10, 1948. 12 p. For publication in Infantry Journal.

It is noted first that because of the necessity for assembling a critical mass in a time interval of the order of a small fraction of a second, it is highly improbable that a nuclear weapon can be developed which will be small enough to be handled by an individual. Second, the methods of detonation and the fusing problems of the bomb are sufficiently complicated to demand a level of training higher than any previously required of members of the Armed Forces. Third, there is at present no adequate protection against the bomb short of preventing its delivery. Fourth, nuclear weapons have not reached their maximum size in the present type bomb; and new types may come into being which will be considerably more powerful than present models; moreover, they are not confined to bombs but, subject to size, may be made as warheads for almost any type of delivery in use today in modern armies. Finally the development of nuclear power for military vehicles is not just around the corner.

ATOMIC POWER

888 Reactor Development, by L. B. Borst. AECD-2172, n.d., decl. July 28, 1948. 3p. For publication in Technical Engineering News.

This report is a general discussion of reactor development with respect to the following uses: (1) production of plutonium for military or other uses; (2) production of industrial power; (3) mobile units for the propulsion of ships, submarines, and possibly locomotives and aircraft ; and (4) research units for the study of various scientific and technological problems.

889 Elementary Pile Theory, by Harry Soodak and Edward C. Campbell. AECD-2201, n.d., decl. August 4, 1948. 76 p. For use as lecture notes.

This discussion of elementary pile theory contains the substance of a series of lectures given in connection with the Clinton Laboratories Training Program (1946-1947) under the direction of Dr. Frederick Seitz. Under this program a group of physicists, chemists, and engineers from academic institutions and industrial laboratories were brought to Oak Ridge for a one-year period. The lectures were designed to present to this group the fundamental ideas associated with the chain-reacting pile. To accomplish this purpose it was deemed sufficient to discuss only homogeneous piles and to consider them from the point of view of the simple diffusion theory.

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ATOMIC POWER

(Continued from preceding page)

Although the methods used in the calculation of heterogeneous piles and the corrections to diffusion theory are interesting and important, they are not essential for a first approach to the subject.

890 Fourth Semiannual Report, Atomic Energy Commission. Washington, Government Printing Office, 1948. 192 p.

A comprehensive account of several phases of the atomic energy program. The following major topics are discussed: proving ground operations; isotopes; particle accelerators; atomic power; construction progress; raw materials program; administration; there are five appendices concerning the use of isotopes.

891 The Relation Between Energy and Mass, by Frederick Seitz, Jr. Electrical Engineering 67, p. 1-5, January 1948.

The atomic bomb has helped to catapult Einstein's mass-energy relationship into the engineers' world. In addition to the accustomed heat reactions of chemistry, there now is possible the release of a million times greater amount of heat from reactions involving the atom nucleus. The following topics are briefly discussed: The mass changes in ordinary chemical and physical processes; the energy associated with ordinary mass; nuclear reactions and mass changes; and the complete conversion of matter into energy.

BIOLOGICAL EFFECTS OF RADIATION

892 Biochemical Studies Relating to the Effects of Radiation and Metals, by Samuel Schwartz. AECD-2198 (CH-3820), January 11, 1947, decl. August 4, 1948. 77p. For publication in NNES.

The biochemical detection of incipient damage resulting from exposure to radiations or to toxic materials has become increasingly important in recent years. This was especially true on the Manhattan Project because of the well known development of late insidious and "irreversible" changes such as anemia and malignancy in individuals with chronic radiation exposure. Unfortunately, however, the successful solution of this problem has been hampered by lack of basic information on the early toxic effects of these materials.

Various biochemical effects of radiation have therefore been studied in 10 patients given total body X-ray in total doses of 75 to 310 r (skin), in 5 patients given 20 to 36 mc P^{32}, and in 5 project personnel accidentally exposed to excessive doses of external radiations. Similar studies have also been made of several hundred Plutonium Project personnel exposed in most instances to relatively small amounts of uranium, lead, and other metals, and to chemicals and radioactive sources. These studies included the investigation of liver function, of white blood cell chemistry, and of various urinary constituents such as coproporphyrin, urorosein and other pigments, urobilinogen, "corticosteroid-like" substances, catalase, and uranium.

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Definitely excessive exposures resulted in various abnormalities in the above tests. With the exception of urinary uranium analysis, none of them were specific in indicating overexposure to either radiation, metals, or chemicals. When interpreted in the light of the exposure and medical history, however, they may aid in the clinical interpretation of relatively marked overexposure. In addition, they may afford further insight into the nature of radiation effects.

The literature on the biochemical effects of radiation is reviewed briefly, and certain suggestions are offered regarding future investigations in this field. 119 references.

893 The Effect of Local Beta Irradiation from an External Source upon the Growth of the Bones and Some Other Tissues of Rats, by M.N. Cupp, H. I. Kohn, and G. E. Stapleton. AECD-2219, July 22, 1948, decl. August 16, 1948. 10 p. Informal disposition. Document for sale by AEC.

One-day-old rats were subjected to one-half (anterior or posterior) body irradiation by the beta rays of P^{32}. The skin exposure on the body was about 1,700 - 2,000 rep. The skin exposure on the tail, hands, feet, forearm, and leg was somewhat less than twice this. The animals were sacrificed at 200 days of age. No cutaneous tumors occurred. The irradiated animals weighed 5 - 10 per cent less than the controls. Males and females reacted alike. Changes were observed only in the part directly irradiated. The "anterior" animals had significantly smaller ears, skulls, and forelimbs; the "posterior" animals had smaller tails, hindlimbs, and testes. Skeletal measurements are given. No effect was observed on the stomach, kidneys, liver, or heart.

894 The Distribution of the Ions Resulting From the Irradiation of Living Cells, by L. H. Gray. British Journal of Radiology, Supplement No. 1, 1947, (Certain Aspects of the Action of Radiation on Living Cells), p. 7-15.

Qualitative effects are the same whatever the radiation used. Differences are due to the various densities of ionization and hence distribution of ions in the cell. Ionization by electrons as shown in the cloud chamber consists of clusters of ions at intervals of about 1 μ. About one third of the ionization is primary and two thirds secondary. There is an average of three ion pairs per cluster. As electron energies increase, ion densities decrease but does not change more than 10 per cent between 25 and 180 kv. An alpha particle is more densely ionizing because of the double charge and speed difference. Heavier particles can maintain greater ion density because of greater momentum. Beta particles may pass through bodies such as bacteria without leaving any ionization behind, or at most one cluster; alpha particles leave many clusters. A table listing ion density produced by different ionizing particles is given.

895 Effects of Radiation on Germ Cells; Dominant Lethals and Hereditary Partial Sterility, by D. E. Lea. British Journal of Radiology, Supplement No. 1, 1947, (Certain Aspects of the Action of Radiation on Living Cells) p. 120-141.

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Chromosome structural changes induced by the irradiation of sperm or eggs may be viable or non-viable. Non-viable structural changes account for dominant lethals, i.e., for failures of zygotes to develop to maturity when the sperm or the egg has been irradiated before fertilization. Viable structural changes give rise (in the mouse) to hereditary partial sterility.

Experimental data on the induction of dominant lethals by X rays and neutrons in Drosophila, Habrobracon, the mouse, rat, guinea pig, rabbit, and frog, and on the induction of viable chromosome structural changes in Drosophila and the mouse, are reviewed. The relation to be expected between the dose of radiation and the yield of viable and non-viable types of chromosome structural change is discussed on the assumptions that: the mean number of chromosome breaks primarily produced in a germ cell is proportional to the dose; a proportion, p, of the breaks primarily produced neither restitute nor exchange with other breaks, but behave as dominant lethals, probably as a result of sister-union of chromatids occurring; and union is random among the remaining breakage ends.

896 Effects of X-rays on the Blood Cells of the Chick, by E. Roberts, L. E. Card, and G. L. Clark. Biodynamica 6, p. 165-176, June 1948.

This work was begun in an investigation of the effect of X-ray treatment on the resistance of chicks to pullorum disease caused by Salmonella pullorum. Because the disease is a septicemia, the effects of the X rays on all the types of blood cells of the classification were studied. This set of data is "apparently the first complete account to be published on that subject." Day-old White Leghorn chicks were irradiated with a total dosage of 360 roentgen (r) units over periods of 120 minutes or 30 minutes. Another series were given a dosage of 720 r units over periods of 120, 30, or 6 minutes. Counts were made on all the blood cells (erythrocytes, heterophils, lymphocytes, monocytes, eosinophils, and basophils) at intervals after treatment ranging from 150 min. to 48 hours. The lymphocytes were considerably reduced following irradiation. This was followed by an immediate decrease in the resistance of the baby chicks to the pullorum disease. There was also a slight reduction in the number of basophils, but the effects on the other cells did not appear significant. In both series of experiments the reduction in number of lymphocytes increased as the exposure time increased although the dosage remained constant. 6 references. 6 tables.

897 The Effect of X-rays on the Lymphatic Nodule, with Reference to the Dose and Relative Sensitivities of Different Species, by P. P. H. De Bruyn. Anatomical Record 101, p. 373-405, July 1948.

Guinea pigs, rabbits, and rats were irradiated with X rays, 200 Kvp, filtered with 0.5 mm of copper and 1.0 mm of aluminum in order to study the relationship between changes in the lymphatic nodules and dose of administration, and to learn whether there is a relationship between the histologic effects of radiation with X rays and their lethal action. The dose rate varied from 11 r/min. to 16 r/min. The amount of X rays which killed 50 per cent of the animals within 30 days (LD 50/30 days) (used as the measure of lethal sensitivity) is 800 r for rabbits, 600 r for rats, and 175 r for guinea pigs. The animals were killed in pairs after irradiation at intervals ranging from 30 min. to 4 months. The mesenteric lymph nodes, patches of Peyer, and, in the rabbit, the appendix also were used after being fixed in Zenker-formol, embedded in celloidin, and stained with hematoxylin-eosin-azure II.

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Doses of 800 r and 600 r destroyed completely the great majority of the lymph nodules in rabbits. The nodules began to regenerate 21 days and 14 days respectively after treatment. A majority of nodules were only partially destroyed after 400 r. These regenerated rapidly and were normal in appearance after 5 days. A dose of 100 r did not produce a marked change in the majority of the nodules, and 50 r was the lowest dose producing histologically detectable changes. Six hundred roentgens and 400 r doses in rats produced changes identical to those in rabbits. However doses of 175 r in guinea pigs produced changes comparable to those in rabbits and rats after irradiation with 400 r or lower. This suggests, considering the LD 50/30 days value of the 3 animals, that the intensity of damage to the lymph node is related to absolute dosage and is independent at the LD 50/30 days of these species. 23 references; 25 figures.

898 The Induction of Chromosome Structural Changes by Radiation; Detailed Quantitative Interpretation, by D. E. Lea. British Journal of Radiology, Supplement No. 1, 1947 (Certain Aspects of the Action of Radiation on Living Cells) p. 85-83.

The following facts can be deduced by analysing quantitative data of the frequency and types of chromosome aberrations obtained when Tradescantia microspores are irradiated at early prophase of the first haploid mitosis: A chromatid can be broken by a single ionizing particle passing through it (or perhaps its immediate vicinity), a high ion-density being necessary if the probability of breakage is to approach unity. Exchanges between breaks are limited to breaks which, at the moment of their production, are separated by distances up to about one micron. Breaks remain capable of exchange, usually, for a period of a few minutes; after this time the majority restitute. It is possible to estimate the proportion of breaks which restitute, although such breaks cannot be recognized microscopically.

899 The Irradiation of Viruses, by P. Bonet-Maury. British Journal of Radiology, Supplement No. 1, 1947, (Certain Aspects of the Action of Radiation on Living Cells) p. 21-29.

Animal viruses were irradiated first with α-rays and then with X rays. The ionization along an α-track is intense and almost certain to be biologically effective throughout its length while the ionization produced by electrons is not so dense and may be less effective per unit length of path owing to the separation in space of the ion clusters produced.

Irradiation of pathogenic viruses, involves a special difficulty, namely of getting a satisfactory measure of the virulence. Techniques are given for the titration of a pathogenic virus, for the alpha irradiation of a virus, and for the irradiation of viruses with other types of radiation. It is concluded that radiation provides a useful method for the study, of ultramicroscopic organisms and is capable of furnishing information not only about the size but also about the structure of viruses.

900 The Nature of Viruses and the Irradiation of Plant Viruses, by Roy Markham, British Journal of Radiology, Supplement No. 1, 1947, (Certain Aspects of the Action of Radiation on Living Cells), p. 16-20.

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Size, appearance, behaviour and composition of viruses are described. Any change in a small virus reduces infectivity or alters properties. A rough estimate of the inactivating effect of radiation is made by irradiating a plant virus of known size and then inoculating leaves. The number of lesions is compared for the irradiated and unirradiated virus.

901 Lethal Effect of Absorbed Radioisotopes on Plants, by J. W. T. Spinks, E. Cumming, R. L. B. Irwin, and T. J. Arnason. Canadian Journal of Research 26 C, p. 249-262, June 1948.

P^{32} in the form of disodium hydrogen phosphate (about 4 mg per microcurie of activity of P^{32}) dissolved in water to give a solution of activity of 0.65 rutherford (10^6 disintegrations per sec.) per ml, and Sr^{90} in the form of a 0.3 per cent solution of strontium chloride, pH = 4.7 and in equilibrium with its Y daughter, were used on wheat, barley, and sunflower seeds. The $Sr^{90} + Y^{90}$ solution had beta activity of 11.7 rd. per ml. Solutions of lower activities were made by dilution of the stock solution. The seeds, in test tubes and supplied with Knop's nutrient solution from which dipotassium hydrogen phosphate was omitted, were subjected to radioactivity ranging from 0.65 rd. to .00065 rd. per ml. after 0, 24, and 48 hrs. germination time in water or soaked Kleenex. Growth measurements were taken. The approximate lethal dose for these isotopes was found to be 0.05 rd. per seed or 1.4 microcuries. 10 references. 7 figures, 1 table.

902 Observations on Crossing Over Induced by X-Rays in the Males of Drosophila, by D. R. Parker. Genetics 33, p. 304-310, May 1948.

The primary purpose of this paper is to open up the question of the relationship between dosage and frequency of induced crossing over to see if this relationship indicates chromatid breakage by a single ionizing particle. Inducing crossing over in the male was found quite restricted in that only a short region of the chromosome can be involved at any time. This is indicated by the preponderance of doubles involving adjacent regions of crossing over, as well as by the occurrence of clusters of crossovers involving adjacent regions. The frequency of double crossing over failed to increase greatly with increased dose. This is to be expected if crossing over is restricted to a region shorter than one marked region. The occurrence of several crossovers in the progeny of some males and absence from the progeny of others is correlated with the presence of growth stages in some testes and absence from the testes of other males of similar age. The cluster effect may be correlated with the similarity of stage of maturation of all cells in a cyst. All cells in one cyst might be similar in their crossing over restrictions at any time. It is therefore suggested that the assumption that crossing over is being induced in the spermatogonia is unnecessary.

Induced crossing over may be interpreted as a result of chromosome breakage by X-rays, with the frequency/dose relationship indicating that both breaks involved in one exchange are produced by a single particle. The absence of lethal position effects does not rule out the explanation of direct breakage by X-rays if both chromatids are broken at the same locus.

BIOLOGICAL EFFECTS OF RADIATION

903 Simulated High Altitude Following Whole-Body Radiation of Mice, by Willie W. Smith, Robert Dooley, and Edwin C. Thompson. Journal of Aviation Medicine 19, p. 227-237, August 1948.

Mice exposed to single doses of 400 to 500 roentgens (r) were subjected to simulated high altitudes of 20,000 to 25,000 feet at periods of 1 to 6 days after irradiation while circulating leukocytes were undergoing reduction, and after 10 to 12 days when platelets and erythrocytes were greatly reduced. Radiation was given at the rate of 64 r per min. (189 KVP, 20 MA, and 0.25 mm. of copper and 0.55 mm. of aluminum added filtration). Five litter-mate pairs were kept in each cage and irradiated simultaneously. One from each pair was taken for the ground group (total 336) and one for the altitude group (total 341). Several non-irradiated mice were always subjected to altitude with the exposed groups. The extent of damage was determined by weight loss, deaths, and hematological changes. There was no evidence found that altitude adversely affected the probability of survival nor did it affect the total or differential counts of circulating leukocytes when they are maximally reduced. The course of diminution and recovery of platelets, erythrocytes, and hemoglobin was not altered by altitude. It is pointed out that the conclusions relative to the absence of altitude effect are based on results with high energy radiation alone, where no vascular effects were observed such as would result from flash burns occurring after atomic bomb detonations. 4 references. 7 figures.

904 Time-Intensity Factors in X-irradiation. Part II. The Influence of the Dosage Rate, by Edith Paterson and M. V. Thompson. British Journal of Radiology 21, p. 414-419, August 1948.

Four groups of experiments were made on chick fibroblasts grown in vitro with the purpose of determining the lethal influence of dosage-rate uncomplicated by other factors. The overall time was kept constant for all the sections of any one experiment. Dose levels of 10,000r to 12,000r were given by 250 kv. continuously evacuated X-ray tubes. Dose-rates of 4r/min. to 5r/min. were contrasted with rates of over 100r/min. The lethal effect of irradiation by a high dosage-rate, highly fractionated, was found to be the same as that of low dosage continuous irradiation. The effect of highly fractionated high dosage-rate irradiation, however, was less than that of irradiation given at the same dosage-rate in fewer fractions but with an interval of over 40 hours. Therefore, dosage-rate as such is of less importance than the dose per fraction or the intervals between fractions, and it may be concluded that, in comparisons between high dosage-rate irradiation given over a short time and that at low dosage-rate continued over a longer period, the operative factor is the overall time. 4 tables.

BIOLOGY, GENERAL

905 The Effect of Rutin upon the Response of the Rat to Total Body X Irradiation, by Henry I. Kohn, P. W. Robinett, and M. N. Cupp. AECD-2176, June 7, 1948, decl. July 22, 1948. 13 p. For publication in a technical journal.

Experiments were performed to determine whether rutin can influence the reaction of the rat to 250 kv X-rays. The drug is the rhamnoglucoside of 3, 5, 7, 3′, 4′ pentahydroxyflavone. In all cases 5 mg per day were given subcutaneously, beginning either on the day of irradiation or 1 week before, and continued for at least 18 days. Oral supplements were also given in some experiments.

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It was found that rutin did not affect the LD-50, the survival following two sublethal exposures, the coagulation time, the thrombocyte count, the total white cell count, and the hemorrhage into the lymph nodes and the gastrointestinal tract. Because rutin is said to affect the hemorrhagic tendency in certain conditions, in vitro studies were carried out on normal human and rat blood. The prothrombin time is not affected, nor the coagulation time. It does not prevent the action of heparin. However, it does antagonize the anti-heparin action of toluidine blue.

906 The Treatment with 2,3-Dimercaptopropanol (BAL) of Acute Systemic Uranium Intoxication in Rats, by Roberta P. Allen and William F. Neuman. AECD-2204 (M-1980), May 26, 1947, decl. August 11, 1948. 18 p. For publication in NNES.

Studies on 2,3-dimercaptopropanol (British Anti-Lewsite; BAL) which have been carried out in the United States (Waters and Stock, Science 102, p. 601-606, 1945) and in England (Peters, Stocken, and Thompson, Nature 156, p. 616, 1945) have shown that this compound is a very effective antidote for several types of heavy metal poisoning. In each case the heavy metal in question is thought to exert its toxic effects by inhibiting essential -SH enzyme systems. The effectiveness of BAL is attributed to its ability to enter into successful competition for the metallic ion and thus insure excretion of the metal as a non-toxic metallo-organic complex.

Albino rats were systemically poisoned intraperitoneally with 3.0 mg per kg of $HgCl_2$ and successfully treated with BAL as late as 30 minutes after the administration. BAL was assayed against the toxic effects of 3 uranium compounds, $UO_2(NO_3)_2 \cdot 6H_2O$, UO_2F_2, and UCl_4, parenterally administered to albino rats with negative results. The negative results were taken as confirmatory evidence for the view that uranium exerts its toxic effects primarily by some other means than a combination with -SH groups.

907 Uranium Tolerance and Citrate Excretion, by Janet Gruschow and Walter Mann. AECD-2212 (UR-23), April 15, 1948, decl. August 10, 1948. 18p. For publication in NNES.

Previously, an acquired tolerance to the toxic action of uranium compounds was developed in two mammalian species, rats and rabbits. In rats made tolerant by repeated injections of uranium, an increased excretion of urinary citrate was demonstrated. In these experiments a tolerance to uranium has been produced in dogs. Further, these tolerant dogs evidenced an increased excretion of urinary citrate. The significance of these results is discussed.

908 The Deposition of Uranium in Bone. Part IV. In Vitro Adsorption Studies, by W. F. Neuman, M. W. Neuman, E. R. Main, and B. J. Mulryan. AECD-2215 (M-2017), March 10, 1948, decl. August 11, 1948. 15p. For publication in Journal of Biological Chemistry and NNES.

Distribution and excretion studies have consistently revealed that a large proportion of parenterally administered uranium is deposited in the skeleton from which it is mobilized slowly. It appeared

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BIOLOGY, GENERAL

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advisable, therefore, to investigate the extent and nature of the affinity of the bone substances for uranium under the more controlled conditions obtainable with preparations in vitro.

Bone ash and fresh bone were equilibrated with uranium in a bicarbonate buffer under a variety of conditions, especially those considered to simulate conditions existing in the animal during uranium poisoning. Observations of the transfer of uranium from the solution to the bone-phase and the simultaneous solution of calcium and phosphorus suggested that the mechanism of fixation at concentrations of uranium occurring in vivo involves an ionic exchange between uranium in solution and some group (probably Ca) on the surface of the bone crystals. This was substantiated by a study of the solubility of uranium in the solutions employed. The ionic exchange occurring in vitro quantitatively accounts for the deposition of uranium in the animal skeleton. 11 references.

CERAMICS

909 Note on the Preparation of Small Dense Beryllia Crucibles, by Helen B. Barlett. AECD-2170 (MPC-2719), August 1945, decl. July 28, 1948. 7p. For publication in Journal of the American Ceramic Society.

As part of the general program on the production of special refractory shapes, a method was developed for producing small, dense, non-porous crucibles of beryllia at a reasonable firing temperature and without the addition of fluxing agents. This method consisted of (a) hot-pressing (150° - 155°C) beryllia containing a thermal-setting, phenol-formaldehyde resin; (b) carefully oxidizing the resin; and (c) firing the crucibles in a small alumina kiln to about 1800°C.

910 Note on Preliminary Work on the Preparation of Small, Dense Crucibles of Thoria-Zirconia, by Helen B. Barlett. AECD-2171 (MPC-2718), n.d., decl. July 28, 1948. 3p. For publication in Journal of the American Ceramic Society.

This is not an abstract; the text of the document is reproduced below in its entirety. Concurrent with the preparation of small, dense crucibles of beryllia, experiments were carried out in an effort to produce dense, non-porous crucibles of pure thoria at firing temperatures around 1800°C. No satisfactory crucibles were made from pure thoria. After trying several different addition agents, however, it was found that by adding about 5 weight per cent zirconia, dense, smooth-surfaced crucibles could be produced.

Thoria (obtained from the Lindsay Light and Chemical Company, West Chicago, Illinois) mixed with 5 weight per cent of zirconia and 6 weight per cent of a phenolformaldehyde resin was pressed in a toggle press. Oxidation of the resin and firing of the crucibles to 1800°C was done in an identical manner with that used for beryllia crucibles.

Considerable difficulty, however, was experienced in the preparation of the crucibles because (a) each lot of thoria from the Lindsay Light and Chemical Company was different from the preceding one, and (b) a proper rate of firing was never uniquely established for thoria crucibles.

Satisfactory crucibles of the thoria-zirconia mixture were prepared. They possessed a glassy, smooth surface and were non-porous. The average shrinkage was 15.6 per cent; the density, 9.15. The calculated density for the mixture of thoria and 5 weight per cent zirconia is about 9.5 indicating that there were very few voids present in the crucibles.

CERAMICS

911 The Preparation of Small Dense Beryllia Crucibles, by O. J. Whittemore, Jr. AECD-2175 (A-4000), December 1945, decl. July 28, 1948. 16 p. For publication in Journal of the American Ceramic Society.

Methods are described for making small dense beryllia crucibles. The methods consist of (a) calcining and grinding the raw beryllia, (b) incorporation of the internal lubricant and an anti-sticking agent, (c) pressing the crucibles at 30,000 psi, (d) burning out the lubricant, and (e) firing the crucibles to 1800°C. Effect of calcination and ball-milling on particle size and their relation with final crucible properties are discussed. The use of Daxad number 23, a polymerized organic salt of sulfonic acid, as an anti-sticking agent is discussed.

912 The Preparation of Small Dense Thoria Crucibles, by O. J. Whittemore, Jr. AECD-2187 December 1945, decl. July 28, 1948. 7p. For publication in Journal of the Americar Ceramic Society.

A method is described for making small dense thoria crucibles with 2 per cent of zirconia added as a flux. Crucibles were pressed from a composition containing a water-soluble wax used as an internal body lubricant. The wax was then burned out and the crucibles fired to 1800°C. The importance of the original properties of the raw material in regard to the ease of producing crucibles is discussed.

CHEMISTRY, ANALYTICAL

913 The Determination of Zinc in the Presence of Uranium, by J. R. McCoy and S. M. Tuthill. AECD-2180, June 1947, decl. July 21, 1948. 11p. For publication in NNES.

A procedure for determining zinc in uranium tetrafluoride and in pitchblende by means of dithizone (diphenylthiocarbazone) is presented. With this procedure it is possible to determine as little as one microgram of zinc, which makes a more sensitive test than the present spectrographic methods. The procedure includes a method for the elimination of nickel and lead which are normally present in pitchblende and which would interfere with the determination of zinc.

914 A Spectrophotometric Method for the Determination of Aluminum in the Presence of Iron Using Ferron, by W. H. Davenport, Jr. AECD-2220 (ORNL-83), July 6, 1948, decl. August 9, 1948. 8p. For publication in Analytical Chemistry.

Aluminum and ferric iron in a buffered acetate-acetic acid solution form complexes with the reagent, ferron (7-iodo-8-hydroxyquinoline-5-sulfonic acid). These complexes are stable for at least 24 hours. The absorption maxima of the two complexes are sufficiently far apart to permit spectrophotometric measurements of (a) the ferric-ferron complex at 600 mμ and (b) the ferric-ferron complex plus the aluminum-ferron complex at 370 mμ. The method is suitable for the accurate determination of 0 - 50 μg of aluminum in the presence of 0 - 100 μg of iron.

CHEMISTRY, ANALYTICAL

915 Aids to Analysis of Patterns Obtained in the Diffraction of Electrons by Gases, by H. J. Yearian and W. M. Barss. Journal of Applied Physics, 19, p.700-704, August 1948.

Three techniques have been found particulary useful in the analysis of the electron diffraction patterns produced in the scattering of electrons by gases. The first is the use of a continuously rotating shutter which is placed directly in front of the photographic plate used to record the patterns. The shutter has an angular opening proportional to the third power of the distance from the center of the pattern and serves to reduce greatly the high background intensity gradient which is characteristic of electron scattering. The second is the application of a Fourier computing scheme to the transformation from intensity curves, derived from observed patterns, to the "radial distribution function" which is of value in selecting a model for the molecule whose structure is being determined by the analysis. The third technique is the computation of patterns corresponding to various molecular models by means of a graphical synthesizer in (sin x)/x. This synthesizer has advantages over the usual numerical computing schemes in that it takes account of the angular variation of atomic structure factor for electron scattering and also makes evident the contributions of scattering by specific atom pairs to the complete synthesized intensity curve.

916 Analytical Work in the Manhattan District Project, by N. Howell Furman. Chemical and Engineering News 26, p. 2490-2492, August 23, 1948.

A general review of all analytical work done in connection with the atomic energy program since its inception. The different analytical methods are briefly mentioned under their proper subheadings (e.g. emission spectroscopy, micro methods, chromatography, etc.). 6 references.

917 The Determination of Radioactive Iron in Biological Material with Particular Reference to Purification and Separation of Iron with Isopropyl Ether, Ashing and Electroplating Technique, and Accuracy of the Method, by Gilber J. Vosburgh, Louis B. Flexner, and Dean B. Cowie. Journal of Biological Chemistry 175, p. 391-404, August 1948.

A method of determination of radioactive iron in biological material is described in which the biological material is prepared for assay of radioactivity by a dry ashing technique. Isopropyl ether is used for the purification of the radioiron and for the separation of iron from substances that interfere with electrodeposition. The iron is extracted from the ashed material with isopropyl ether and then removed from the ether with ammonium oxalate solution. The iron is electroplated from ferric ammonium oxalate onto a copper dish, and the radioactivity is measured. Complete recovery is obtained of radioiron added to samples of blood cells, plasma, and carcass, and the values for recovery lie within limits imposed by statistical fluctuation in radioactive disintegration.

918 A Method for the Measurement of Radioiodine in Biological Materials, by Michael C. Barry. Journal of Biological Chemistry 175, p. 179-185, August 1948.

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CHEMISTRY, ANALYTICAL

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A method for measuring radioactive iodine, I^{131}, in the normal rat thyroid is described in which the iodine in the sample is oxidized to iodate by a modification of the permanganate acid method, reduced to iodide, and the iodide precipitated as palladium iodide after the addition of a controlled amount of carrier iodide. By this means there is obtained a controlled weight of I^{131}-containing precipitate which is independent of variations in the chemical composition and the amount of the original sample, and which may be easily filtered off for radioactivity measurement. A sensitivity of 0.17 millirutherford is achieved and an ultimate sensitivity of at least 4×10^{-3} millirutherford, 10^{-4} microcurie is possible with the technique described. The method permits recoveries of 99 per cent of added radioiodine and is readily adaptable to other biological materials.

919 "Nucleonics and Analytical Chemistry" Symposium Subject. Nucleonics 3, No. 2, p. 65, August 1948.

The following papers were presented at the symposium on nucleonics and analytical chemistry held by the American Chemical Society at Northwestern University on August 13 and 14.

Instruments Employed in the Measurements of Radioactivity, by C. J. Borkowski;
Techniques Employed in Applied Radiochemistry, by W. H. Sullivan;
Radioactive Isotopes as Tracers, by P. Yankwich;
Determination of Natural Occurring Radioactive Elements, by C. J. Rodden;
Activity Analysis, by D. N. Hume;
Activation Analysis, by G. E. Boyd;
Industrial Applications, by J. W. Irvine, Jr.;
Preparation and Procurement of Radioactive Materials, by N. H. Woodruff and S. A. Lough.

920 Principles and Position of the Development of Spectrochemical Apparatus and Methods, by H. Moritz. Archiv für Metallkunde 1, p. 102-108, 1947.

This article reviews the fundamental principles, latest types of apparatus, and modern techniques of spectrochemical analysis.

921 Thermogravimetrics of Analytical Precipitates. Part VI. Determination of Beryllium. [Sur la Thermogravimetrie Des Precipites Analytiques. VI. Dosage du Glucinium (Béryllium)], by Therese Duval and Clement Duval. Analytica Chimica Acta 2, p. 53-56, February 1948. (In French).

The authors have studied, by means of the Chevenard thermobalance, the pyrolysis of the hydroxide, crystalline sulphate, amorphous sulphate and ammoniacal phosphate of beryllium. They recommend the apparatus for carrying out the automatic determination of beryllia after heating to 951° only, instead of 1200°C. They give reasons why weighing as anhydrous sulphate is far from being satisfactory and indicate their perference for the pyrophosphate.

CHEMISTRY, GENERAL

922 Preparation of Boron Trifluoride for Use in Neutron Counters, by W. Hodges, M.I. Lloyd, and B. Weinstock. AECD-2223 (LADC-450), n.d., decl. August 9, 1948. 10p. Informal disposition.

Boron trifluoride is used as the filling gas in ionization chambers and in proportional counters used for counting neutrons. One feature of a neutron counter which is generally desirable is a high counting efficiency, i.e., where a large percentage of the neutron flux gives rise to reaction. However, the presence of impurities in the gas cause poor operating characteristics. When pure BF_3 is used in a counter, good voltage and bias plateaus are obtained. The pulses tend to be more uniform in size and well separated above the noise background. With impurities in the BF_3, this situation degenerates to the point where the counter cannot be reliably used.

The method of preparation described has yielded BF_3 of excellent quality for use in neutron counters. It consists essentially of converting BF_3 into calcium fluoborate and subsequently regenerating the BF_3 by the thermal decomposition of this compound. The method was suggested by the fact that small samples of boron with enriched B^{10} concentration were available as the dimethyl ether compound; this compound is readily converted to calcium fluoborate. The method has the additional advantages of giving high yields (over 85%) and requiring simple inexpensive apparatus. A suitable method of BF_3 storage is necessary; a well outgassed glass bulb with a mercury valve was found to be satisfactory for storage purposes. The filling of ionization chambers from the storage bulb is discussed in detail.

923 Synthesis of Ethanol-1-C^{14}, Ethanol-2-C^{14}, Ethyl Bromide-1-C^{14}, Ethyl Bromide-2-C^{14}, and C^{14}-Labeled Methadon, by B. M. Tolbert, Freda Christenson, Frances Nai-Hsuan Chang, and Peter P. T. Sah. AECD-2225 (UCRL-136), June 22, 1948, decl. August 17, 1948. 18p. For publication in Journal of the American Chemical Society.

Ethanol-1-C^{14}, ethanol-2-C^{14}, ethyl bromide-1-C^{14}, and ethyl bromide-2-C^{14} have been prepared from labeled acetic acid by high yield synthetic procedures on a 10-20 millimole scale. DL-methadon (4,4-diphenyl-6-dimethylamino-3-heptanone) has been prepared labeled with C^{14} in either the 1 or 2 position.

924 Fluoberyllates, by Bhupesh Chandra Purkayastha. Journal of the Indian Chemical Society 24, p. 257-262, 1947.

Using NH_4F, thermometric and conductometric titrations of $BeSO_4$, BeF_2, and $(NH_4)_2BeF_2$ were made. The breaks in the titration curves indicated the composition of the various solutions at which complex formations took place. It appears that four fluorberyllate ions, $(BeF_3)^{-1}$, $(BeF_4)^{-2}$, $(BeF_5)^{-3}$ and $(BeF_6)^{-4}$ exist in solution.

925 A Radioactive Estrogen Compound (Sur un Oestrogene Radioactif), by Pierre Sue, Jean Jacques, Alain Horeau, and Robert Courrier. Comptes Rendus 227, p. 8-9, July 5, 1948. (In French)

The bromine derivative of a synthetic estrogen (acide dimethylethylallenolique) was found to be water soluble and thus could be used in intravenous injections which facilitated its diffusion and detection. It

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CHEMISTRY, GENERAL

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was found to be active in amounts which ranged from 10 γ to 20 γ when injected into castrated rats. The radioactive compound was prepared by incorporating radioactive bromine into the naphthalene nucleus of the synthetic estrogen.

926 Reactions of Zirconium with Gases at Low Pressure, by W. G. Guldner and L. A. Wooten. Journal of the Electrochemical Society 93, p. 223-234, 1948.

Data on the reaction of Zr with O, N, CO, CO_2, H, and H_2O vapor in the micron pressure range are presented. Electron and X-ray diffraction analysis were used to study the reactions products. Both ZrO_2 and ZrC are formed when Zr metal powder is exposed to CO or CO_2 in the temperature range of 600° to 800°. It was also found that ductile Zr strip can dissolve as much as 38 atoms per cent of oxygen without the formation of a new phase. A new apparatus for the study of gas-metal reactions at low pressure is described.

CORROSION AND ANTI-CORROSION

927 Bibliographic Survey of Corrosion, by R. D. Misch, J. T. Waber, and H. J. McDonald. Bremen, Ga., National Association of Corrosion Engineers, 1948.

928 Corrosion and the Periodic System, by K. Wickert. Archiv für Metallkunde 1, p. 278-281, 1947.

Corrosion properties as well as physical and chemical properties can be explained when metals are grouped in the periodic system according to their electron-giving - electron-taking properties. The various groups are described together with the positions, in the classification, of the components of the Hume-Rothery phases, the Zintl compounds, and the Laves phases.

929 Corrosion Prevention and Protection, by F. R. Morral. Wire and Wire Products, 22, p. 133-138, 175, 1947.

The factors to be considered in an analysis of any corrosion problem are given. A bibliography of 109 references is included.

COSMIC RADIATION

930 Cloud Chamber Study of Meson Disintegration, by R. W. Thompson. Physical Review 74, p. 490-491, August 15, 1948.

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COSMIC RADIATION

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Several cloud-chamber photographs at sea level showing mesons which come to rest and disintegrate were obtained. The results seem to indicate a preponderance of momenta of the disintegration particles in the range 40-50 Mev/c. The momentum of the disintegration particle is of particular interest because some information can be obtained therefrom concerning the disintegration scheme of the meson. A diagram of the apparatus used in detecting these disintegrations is given.

931 Cosmic-Ray Showers Produced by Penetrating Particles, by C. Y. Chao. Physical Review 74, p. 492-494, August 15, 1948.

A series of stereographic cloud-chamber pictures has been taken to study shower production by penetrating particles at sea level. The total number of pictures taken in 184 hrs. total sensitive time of the triggering apparatus was 545. Those pictures in which (1) the initiating particle traversed at least one lead plate before starting the shower, (2) at least 10 shower particles are visible, and (3) the shower propagated through at least one lead plate, are considered. It seems probable that the mixed showers were largely produced by primary protons. It also appears that the contribution to both electron showers and mixed showers by non-ionizing, penetrating particles is much smaller than that by ionizing, penetrating particles. A table of results is given.

932 Magnetic Variable Stars as Sources of Cosmic Rays, by Horace W. Babcock. Physical Review 74, p. 489, August 15, 1948.

The observed variations in the general magnetic field of HD 125248 and some other stars give evidence for specific sources of cosmic rays according to either Swann's (Physical Review 43, p. 217, 1933)or Davis's (Physical Review 72, p. 632 1947) theory.

933 Observations on the Production of Mesons by Cosmic Radiation, by G. P. S. Occhialini and C. F. Powell. Nature 162, p. 168-173, July 31, 1948.

Photographic plates were exposed to cosmic radiation at about 10,000 ft. and 18,000 ft. Twenty nuclear explosions, accompanied by emission of slow mesons, were observed. Photomicrographs of the meson tracks are given and particular attention is called to the need for caution in interpreting results from these tracks.

Examples of secondary effects, such as the elastic collisions of protons, deuterons, and tritons, with nuclei of hydrogen and other elements in the emulsion, were found; as was the fact that the mesons produced have a high probability, when reduced to low velocities, of producing nuclear disintegrations of elements, with the emission of heavy particles. Their behavior, therefore, is consistent with the view that they have a strong interaction with nucleons. An account of all observations can be given in terms of positive or negative mesons of mass $\sim 320\ m_e$ and $\sim 200\ m_e$.

COSMIC RADIATION

934 Rate of Production of Helium in Meteorites by Cosmic Radiation, by Carl August Bauer. Physical Review 74, p. 501-502, August 15, 1948.

Evidences are given that cosmic radiation has produced helium in metallic meteorites. Accepting the observations that the difference in helium content of different fragments and the difference from point to point in the same fragment as indications that cosmic radiation has produced the helium in Bethany meteorite, one can conclude that the time since the solidification of the metallic core of the parent plant is less than 60 million years. This upper limit is set since the U and Th contents of the meteorite are sufficient to produce all of its helium in only 60 million years.

935 Two Soviet Scientists Discover New Particles. Nucleonics 3, No. 2, p. 66, August 1948.

Fourteen new subatomic particles, identified as "varitrons" in cosmic rays, were discovered. The particles have masses of 100, 150, 250, 300, 430, 550, 680, 1000, 1300, 2500, 3800, 8000 and 25,000 electron masses.

CRYSTALLOGRAPHY

936 An Analytical Discussion of the Construction of Pole Figures, by John K. Wood. Journal of Applied Physics 19, p. 784-790, August 1948.

The construction of pole figures of crystal orientation data obtained by means of X-rays can be made quickly and accurately if the angular relationships between planes or "poles" are known and if all of the data from a diffraction pattern are used. A flexible set of equations is derived from which these relationships can be found starting with customary crystallographic information. Data for an hypothetical case of diffraction are computed to illustrate the method. Although the examples refer, for the most part, to cubic crystals, the method can be extended to cover other types.

937 Geiger Counter Measurements of Bragg and Diffuse Scattering of X-Rays by Single Crystals, by Kathleen Lonsdale. Acta Crystallographica 1, p. 12-20, March 1948. (In English).

The advantages and limitations of the use of Geiger counter equipment for the measurement of scattering intensity from small single crystals are discussed. An investigation was made of the effect of the presence of varying amounts of white radiation in the incident and reflected beams. A study was made of crystals of urea and of oxalic acid dihydrate before and after immersion in liquid air, using CuK and MoK radiations, with argon-and krypton-filled counter tubes. It is concluded that thermal diffuse scattering is independent of crystal perfection.

938 Statistical Factors Affecting the Intensity of X-Rays Diffracted by Crystalline Powders, by Leroy Alexander, Harold P. Klug, and Elizabeth Kummer. Journal of Applied Physics 19, p. 742-753, August 1948.

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CRYSTALLOGRAPHY

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The Laplacian probability equation can be used to predict the reproducibility of the intensities of X rays diffracted by crystalline powders. If absorption is neglected, and N is the number of particles irradiated, p the proportion of particles which are oriented so as to diffract, and $q = 1 - p$, the relative mean deviation to be expected in repeated intensity measurements is given by $U_m = 0.798(q/Np)^{\frac{1}{2}}$. When absorption and the actual distribution of particle sizes are taken into account, the expression becomes $U_m = 0.798(q\mu v_e/pA)^{\frac{1}{2}}$, where μ is the linear absorption coefficient of the material, v_e the effective volume per particle, and A the cross-sectional area of the incident beam.

The theory is confirmed by measurements on four size fractions of quartz powder using a Norelco Geiger-counter x-ray spectrometer. For typical experimental conditions and powders of medium absorbing power for X rays, it is demonstrated that good reproducibility can be expected only if the effective particle dimension is less than approximately five microns.

FLUOROCARBONS

939 New Products and Materials; o-Chlorobenzotrifluoride, by Richard W. Porter, assistant editor. Chemical Engineering 55, No. 8, p. 163, August 1948.

Pilot plant quantities of o-chlorobenzotrifluoride (o-chlorotrifluoromethylbenzene) are being manufactured by the Hooker Electrochemical Co., Niagara Falls, N.Y. It is potentially of interest as an intermediate in the preparation of various chemicals and dyestuffs and as a special solvent and dielectric fluid. A colorless, aromatic liquid it is characterized by the CF_3 group. This radical is generally stable to light, heat and chemical reaction. Its distillation range is 150.9° to 152.4°C. Freezing point is -7.4°C.; and its specific gravity at 15.5°C. is 1.379.

GEOPHYSICS

940 Some Mechanisms for the Fixation of Uranium in Certain Sediments, by A. F. Frederickson. Science 108, p. 184-185, August 20, 1948.

A new theory for the concentration of uranium in the sedimentary crust of the earth is given. It is suggested that large UO_2^{++} ions are formed and that these, adsorbed between graphite layers of carbonaceous material, may form a strong structure. The uranium may be in the form of adsorbed ions and not of discrete minerals, due to base exchange on clays and other layer-lattice minerals. The conclusion is that if the source containing uranium is weathered to clays with a high base exchange capacity, these clays show a high radioactivity. Support for the theory is given by the fact that kaolinite, which has almost no base exchange capacity, has negligible radioactivity. Several samples are compared supporting the theory.

HEALTH PROTECTION

941 Health Physics and Radiation Protection, by Karl Z. Morgan. AECD-2217, n.d., decl. May 27, 1948. 22p. For publication in a book.

Health Physics is defined as that branch of knowledge which is devoted to a study of radiation and dedicated to the development of means by which radiation exposure to man may be kept to a minimum. Some of the history of the development of Health Physics is reviewed along with the radiation protection problems which arose with the atomic energy program. The development of suitable radiation detection instruments is discussed and the instruments classed according to their use: (1) personnel monitoring, (2) area monitoring, and (3) survey instruments. A summary table of some calculated radiation tolerance values for several radioisotopes is given. Educational and research programs for Health Physics are discussed on the basis of immediate and future needs.

942 Atomic Armor, by Ralph P. Eames. Safety Engineering 96, No. 2, p. 26-30, August 1948.

A general discussion on the protective measures and equipment being used to counteract atomic radiation dangers is presented. The different types of radiation distribution (point, line, area, and volume) and detecting devices, such as air monitors, ionization chambers, dosimeters, and Lauritsen electroscope, are briefly explained.

943 Physical and Medical Aspects of Radiation, by L. L. German and H. M. Rozendaal. Electrical Engineering 67, p. 884-890, September 1948.

This presentation of the practice of health physics and of the hazards of radiation does not lay claim to completeness. Its purpose is to show the fundamental organization of a radiation protection group, the methods and instruments it uses, and some of the histological effects of radiation it guards against. The health physics staff of the Knolls Atomic Power Laboratory, Schenectady, N.Y., and its work as a protection group is used as an example.

944 Problems of Medical Care in the Atomic Age, by Harold C. Lueth. Illinois Medical Journal 94, p. 93-99, August 1948.

This paper has the thesis that just as gunpowder had a great effect upon the social scene in hastening the decline of the feudal system, and became an additional threat to physical well-being, so too the atomic bomb portends social change and becomes an additional threat to physical well-being. Thus it behooves the medical profession to develop plans for medical care in an atomic age. The effects of blast, heat, and ionizing radiations of the bomb are reviewed.

945 Problems of Radioactive Waste Disposal, by Forrest Western. Nucleonics 3, No. 2, p. 43-49, August 1948.

The nature of the waste disposal problem as well as the general principles by which the problem may eventually be solved are mentioned. The possibilities of disposal are: (1) Dilution, where care must

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HEALTH PROTECTION

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be taken that the radioactive chemicals do not become concentrated by absorption or adsorption. (2) Dilution by mixing with one or more stable isotopes of the same chemical element. (3) Storage to allow decay to stable isotopes. (4) Concentration of radioactive materials by removal from process fluids by ion exchange, adsorption, precipitation, sedimentation, extraction, and evaporation. (5) Placing in containers and disposal of materials in the ocean. Tables are given of tolerance concentrations of various radioisotopes in drinking water, decay time of some fission products, and activities of certain long-life fission products in pile after 100 days.

INSTRUMENTS

946 The Design and Construction of a Test Instrument for the Model-356 Zeuto, by G. P. Apprill. AECD-2188 (LADC-545), June 30, 1948, decl. August 4, 1948. 22p. Informal disposition. This also includes declassification of the Zeuto test instrument.

The Zeuto Tester described is a test instrument designed exclusively for the Victoreen Model-356 Alpha Meter. Essentially it is a plug-in type volt-current meter which will measure all voltages and currents in the leads between the batteries and the circuit box. From this voltage-current analysis the majority of circuit troubles can be located. It permits batteries to be checked while normally loaded, thereby eliminating the possibility of misleading checks which often occur when only a high impedance voltmeter is used. A 1000 ohm volt meter is used which, of course, places a slight load on the batteries when they are checked unloaded by the Zeuto circuit. The two voltage checking methods are described. The tester measures total filament current, total plate current, and the bleeder current of the 3-volt bias battery E4. The current checks give a good indication of circuit conditions. Illustrations and specifications are included.

947 A Laboratory Size Induction Stirrer for Closed Systems, by B. M. Tolbert, William G. Dauben, and James C. Reid. AECD-2202 (UCRL-135), June 22, 1948, decl. August 6, 1948. 11p. For publication in Analytical Chemistry. This also includes declassification of the induction stirrer.

Numerous internal stirrers have been devised for the agitation of liquids in closed systems. Most of the devices are of the magnetic type and are so designed that the mechanism required to establish a rotating or an alternating vertical field outside the reaction flask is cumbersome and impractical when the reaction flask must be immersed in a cooling or a heating bath. Most stirrers also have many other drawbacks such as low power developed, complex construction details, and lack of versatility. A simple induction stirrer which circumvents many of the above difficulties has been previously described (Dauben, Reid, and Yankwich, Analytical Chemistry 19, p. 828, 1947); an improved design of this earlier model is given in this document. It can develop high speed and fair power, and does not interfere with the use of cooling or heating baths.

INSTRUMENTS

948 Electronics, by William C. Elmore and Matthew L. Sands. AECD-2208 (LADC-236; LADC-249), October 28, 1946, decl. August 2, 1948. 447p. For publication in NNES.

This document consists of seven sections numbered AECD-2208-A through AECD-2208-G. These sections are individually abstracted below.

948-A Section I. Circuit Components and Construction Practice, by William C. Elmore. AECD-2208-A. 30p.

A brief discussion of components which have been found suitable for constructing the various electronic circuits described in the remainder of this document is given. An exhaustive treatment of circuit components is not made nor is information of the sort readily available in standard handbooks or the catalogs of manufacturers presented. A description is given of a number of different methods which have been used at Los Alamos for the mechanical construction of electronic circuits. It is felt that a discussion of these two matters will be useful to anyone wishing to build electronic apparatus for research purposes.

The following circuit components are described: resistors, capacitors, inductors, transformers, vacuum tubes, cables, and cable connectors. Laboratory equipment useful in the design, construction, and testing of electronic devices is described.

948-B Section II. Circuit Elements, by William C. Elmore and Matthew L. Sands. AECD-2208-B. 108p.

A variety of different circuit elements are described and discussed which constitute the "building blocks" of the complete circuits described in later sections of the document. The design of a complicated electronic circuit is shown to proceed first in the drawing of a block diagram of circuit elements, each of which must perform a simple function, and then in the designing of the individual elements. The most commonly found elements in electronic circuits devised for research in nuclear physics, and for the studying and recording of fast electrical transients, are described.

It has been found convenient to divide circuit elements into four categories: linear passive elements, linear electronic elements, trigger circuits, and other non-linear electronic elements. The following linear passive elements are discussed: resistance networks, resistance-capacitance networks, resistance-capacitance-inductance networks, and delay lines. Linear electronic elements included are: single triode and pentode voltage amplifier stages, phase inverters, difference amplifiers, the cathode follower, two- and three-stage feedback loops, linear oscillators (RC oscillator, LC oscillator, and crystal oscillators), constant-current devices, some properties of feedback circuits, relaxation oscillators (thyratron oscillator, multivibrator, and blocking oscillator), trigger circuits with one stable state (thyratron circuits, univibrator, and blocking oscillator), trigger circuits with two stable states (thyratron circuits, flip-flop, and Schmidt trigger circuit), and methods of triggering. Non-linear elements discussed are gates, mixers, and coincidence circuits.

INSTRUMENTS

948-C Section III. Voltage Amplifiers, by William C. Elmore. AECD-2208-C. 90p.

Linear voltage amplifiers which are useful in nuclear physics investigations are discussed. Some consideration, however, is given to amplifiers intended to be used in oscillographs for the recording of fast electrical transients, and to other miscellaneous types of amplifiers. The first portion of the chapter is devoted to the design of pulse amplifiers used in nuclear physics. The latter portion of the chapter contains the description of a number of different amplifier circuits, all of which have been used extensively in experimental work.

The following topics are discussed in detail: voltage waveforms encountered in pulse amplifiers, wideband amplifier theory (low-frequency and high-frequency considerations), design nomographs for wideband amplifiers, amplifier noise, pulse amplifiers, transient amplifiers, d-c amplifiers, and miscellaneous amplifiers.

948-D Section IV. Electronic Counters, by William C. Elmore and Matthew L. Sands. AECD-2208-D. 86p.

Consideration is given to several practical circuits which record the occurrence of each of a large number of electrical pulses possessing certain restricted properties of amplitude and of time of occurrence. Particular attention is given to voltage pulses from a pulse amplifier of the type discussed in Section III. A circuit for recording the occurrence of pulses is called a counter. First to be considered are counters which are suitable for the measurement of the amplitude distribution of pulses, and secondly counters whose function is to record the occurrence of groups of pulses, all of similar magnitude, which appear with a specified time relationship among themselves.

Counters which fall into the first-mentioned category are composed of three essential parts, (1) a discriminator, (2) an electronic tallying circuit, or scaler, and (3) a circuit for operating an electromechanical impulse register. Several forms of each of these basic circuits are discussed, preceding the description of complete counter circuits. Time discriminators and several time-discriminator circuits are described in detail for counter circuits which fall in the second category.

948-E Section V. Oscillographs and Associated Equipment, by William C. Elmore. AECD-2208-E. 28p.

The cathode-ray oscillograph plays an indispensible part in studying phenomena which occur in times too short to make other means of recording possible. Experience with ordinary cathode-ray tubes, such as the type 5CP11, and with available photographic emulsions and cameras, indicates that it is quite feasible to obtain usable photographs with writing speeds of 15 or more inches per microsecond. (By using the newly developed type 5RP11 tube with an accelerating potential of 35 kv, writing speeds in excess of 200 inches per microsecond can be photographed.) Unfortunately there are no commercial oscillographs available which are really suitable for the majority of research problems where fast, single transients must be photographed. The situation is equally bad if it is desired to record or to observe transients which occur randomly distributed in time, as for example, pulses from an electrical detector exposed to radiation from a radioactive source.

At least three important types of situations are met in photographically recording or visually observing electrical transients. In the first type of situation an electrical signal, or trigger, is used to initiate the entire sequence of events, causing both the phenomenon to occur, and the cathode-ray spot to sweep

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across the cathode-ray tube at exactly the right moment for recording or observing the electrical signal produced by some aspect of the phenomenon. In the second type of situation, some aspect of the phenomenon itself is used to initiate the sweep at the proper moment so that transients occurring later in time can be recorded. In the third type of situation, no previous signals are available to initiate the sweep, so the signal itself must be used as a trigger. To avoid losing a record of the leading edge of the signal, the signal can be passed through a high-fidelity delay line before it reaches the deflecting plates of the cathode-ray tube.

Evidently it is necessary to have a sweep circuit which will respond whenever it receives a suitable trigger. A sweep of this type is often termed a slave sweep. In some cases it is desirable that the system contain a locking circuit to prevent more than a single sweep from occurring. This is important if the trigger is derived from the phenomenon itself, since trigger pulses following the initial trigger may inadvertently cause additional sweeps, and therefore confuse the record. Another important type of circuit is used for delaying triggers in order that the sweep can be started at the correct instant in time. Still another type of circuit is often necessary in order that time fiducials be placed on the record either along with the signal being recorded, or at an earlier or later time, but on the same piece of photographic film. Circuits, therefore, must be available either to produce narrow timing pulses, which may be mixed with the signal, or to blank the oscilloscope trace at regular known intervals.

A number of practical circuits are described for accomplishing the various tasks which have been mentioned. Considered are cathode-ray tubes, a sweep circiut, time marker generators (pip generators and blanking generators), trigger delay circuits, and a trace-brightening circuit.

948-F Section VI. Test and Calibration Equipment, by William C. Elmore. AECD-2208-F. 55p.

The circuits described in this document require for the most part special equipment in order to be adequately tested. The simplest tests made usually involve measuring various circuit voltages, and, with the aid of an oscilloscope, observing the waveforms of signals which exist at various points in the circuit. To test many of the circuits, pulses must be provided which bear a definite time relationship to the start of the sweep of the oscillograph. One purpose of this section is to describe suitable pulse generators and sweep circuits for general laboratory testing.

Another problem likely to arise concerns the calibration of certain circuits, some of which may be used for measuring the amplitude of pulses, and other for setting the time scale in an experiment. Where an accurate pulse height calibration must be made, it is necessary to have available a voltage pulse generator which delivers pulses of standard shape and of known amplitude. For calibrating time scales, equipment of various types may be needed, depending on the problem at hand. Probably the most accurate time calibration can be done with a circular sweep oscilloscope whose timing is based on a crystal-controlled oscillator. Often it is more convenient to employ a double pulse generator, where the separation of the two pulses can be accurately controlled. Several circuits for carrying out amplitude and time calibration are discussed. Included also are brief discussions of some commonly used procedures both for general circuit testing, and for carrying out the calibrations which can be made with the equipment described. Contents include a discussion of laboratory oscillographs, voltage pulse generators, equipment and methods for making time calibrations, and some useful testing aids.

INSTRUMENTS

948-G Section VII. Power Supplies and Control Circuits, by William C. Elmore. AECD-2208-G. 50p.

The first part of this section contains a description of a number of typical power supplies, most of them electronically stabilized. These supplies, or simple modifications of them, have been used with the various circuits which are described in the preceding sections. The second part of the section is devoted to control circuits of various types useful in certain types of laboratory work. Contents include simple theory of voltage stabilizing circuits of the degenerative type, VR-tube stabilized supplies, medium-voltage stabilized supplies, high-voltage supplies, r-f high-voltage supplies, a constant-current magnet supply, a stabilized heater power-supply, model-600 ion gauge control, valve control for Toepler pump, a plating cell control, an on-off thermostat control, and an integrating current meter.

949 A Simple Recording System for Small Currents, by G. W. Monk. AECD-2214 (Y-123), February 4, 1948, decl. August 16, 1948. 3p. For publication in Review of Scientific Instruments. This also includes declassification of the recording system for small currents.

A recording system is described which is especially suited for recording small currents of the order of 10^{-13} amperes. A circuit diagram for use with the Brown "Electronik" recorder is included.

950 Discharge Spread in Geiger Counters with Methane and Methane/Argon Fillings, by C. Balakrishnan, J. D. Craggs, and A. A. Jaffe. Physical Review 74, p. 410-414, August 15, 1948.

Further measurements with a split-cathode Geiger counter filled with methane and methane/argon mixtures are described. The study of discharge spreading by photo-ionization of the gas in Geiger counters containing methane and methane/argon mixtures tends to support Korff's view that the photo-ionizing radiations are produced mainly in the argon and are quenched by the methane. The higher absorption and lower extent of discharge spreading in argon/CH_4, as compared with CH_4 only at the same pressure, would tend to show that absorption in argon is predominant when CH_4 is present, but the probable differences in the spectra obtained in the two cases make detailed interpretation difficult.

951 The Electron Microscope and Its Application to Materials Problems, by J. I. Wittebort. ATI Technical Data Digest 13, p. 9-20, June 15, 1948.

The electron microscope provides a new means of determining the size and shape of finely divided matter and aggregates such as dusts, smokes, powders, pigments, colloidal suspensions, crystals, micromolecules, plastics, elastomers, and textile fibers ranging in size from 10μ down to less than 1/100μ. It also provides through the use of surface replica techniques a means for revealing surface details of metals, ceramics, and surface finishes far beyond the scope of the best light microscope. The instrument can be converted into a precision electron diffraction camera suitable for the identification of microquantities of crystalline materials from their characteristic diffraction patterns. In this paper are discussed theoretical aspects of resolution, design of the instrument, specimen and replica preparation, image formation, theoretical considerations regarding electron diffraction, application to material problems, and future prospects of this instrument. (TIP)

INSTRUMENTS

952 New Geiger Counter. Chemistry 21, p.45, July 1948.

U.S. Patent 2,442,314, has been issued to Allen F. Reid of New York and assigned to the A.E.C. It is on a new type of Geiger counter in which the quenching gas is a hydrocarbon containing six carbon atoms, combined with a single atom of fluorine or other halogen element, instead of the lead tetramethyl now used.

953 A Note on Ethylene Self-Quenching G-M Counters, by K. H. Morganstern, C. L. Cowan, and A. L. Hughes. Physical Review 74, p. 499-500, August 15, 1948.

Alcohol, ether, ethylene, and cyclopropane were used with argon in Geiger-Müller counters. Of all gases, ethylene gave the best results, having long, flat plateaus over a wide range of partial pressures, was dependable under temperature changes; gave no multiple counts; and did not react with the Zapon window.

954 Theory and Operation of Geiger-Müller Counters. Part II. Counters for specific purposes, by Sanborn C. Brown. Nucleonics 3, No. 2, p. 50-64, August 1948.

A critical discussion of the behavior of various types of counters, including details of construction and operation, is given. Gamma, beta, and X-ray counters, as well as optical photon, liquid, and gaseous source counters, are included in the discussion. Special counters reviewed are unusual size counters, large solid-angle counters, and low voltage counters. This is the second of three articles. The first paper "Theory and operation of Geiger-Müller counters," was abstracted in Nuclear Science Abstracts 1, No. 3, August 15, 1948, Abstract No. 463.

ISOTOPES

955 He^3 Isotopic Abundance Measurement by Counter Technique, by J. H. Coon. AECD-2207 (LADC-532), June 9, 1948, decl. August 9, 1948. 18p. For publication in Physical Review.

Analysis of He^3 concentrations is of importance because of the interest in He^3 for nuclear investigations in the light element region. In the present work, measurements were made of the isotopic abundance of He^3 in two samples of natural helium, one from wells near Amarillo, Texas, and one from air reduction processing. The method of measurement is applicable to analysis of the He^3 content of enriched samples prepared by thermal diffusion methods or by the production of He^3 through the decay of H^3. Briefly it consists of detecting the $He^3(n,p)H^3$ disintegrations induced by thermal neutrons. The helium gas is put into a proportional counter, the disintegration rate compared to that with nitrogen in the counter, and the He^3 content deduced by using the known ratio of the He^3 and N disintegration cross section.

ISOTOPES

956 The Relative Abundance of the Zinc Isotopes, by M. G. Inghram and D. C. Hess, Jr. AECD-2209 (ANL-AJD-252), July 14, 1948, decl. August 4, 1948. 2p. For publication in a suitable technical journal.

This is not an abstract; the text of the document is reproduced in its entirety.

In the course of an examination of a sample of zinc for possible alterations in its isotope abundances (ANL-4012, p. 11, July 1947), we were led to revise the values for the normal abundances, in the same direction as was later reported in the letter by W. T. Leland and A. O. Nier (Physical Review 73, p. 1206, 1948). Our measurements were carried out both on samples of zinc prepared by chemical reduction of the ore and on samples of electrolytic zinc, and extend the results reported in the letter referred to.

We were at first surprised to find that our samples, and even samples of commercial zinc showed a large apparent enrichment of the heavy isotopes over the light when compared with Dr. Nier's values of 1936. On learning from the metallurgists that most zinc is now made by an electrolytic process, while twelve years ago, when Dr. Nier's determinations were made (Physical Review 50, p. 1041, 1936), commercial zinc was almost exclusively made by chemical reduction of the ore, followed by a purification by evaporation, we investigated the possibility that this earlier process might have produced the apparent enhancement of the light isotopes. This proved not to be the case; a sample of chemically reduced zinc and a sample of electrolytic zinc could not be distinguished within the accuracy of our measurements as shown in the values given in Table I, lines 2 and 3.

Table I. Abundance of the Zinc Isotopes

Mass	64	66	67	68	70
Nier, 1936	50.9	27.3	3.9	17.4	0.5
Electrolytic, I & H	48.89	27.82	4.14	18.54	0.617
Chemical, I & H	48.90	27.82	4.17	18.48	0.623
Leland and Nier, 1948	48.89	27.81	4.07	18.61	0.620

It should be pointed out that the 1936 values of Nier for the abundances of the zinc isotopes have been used as standards for photometric measurements by Ewald (Zeitschrift für Physik 122, p. 487, 1944) and by Duckworth and Hogg (Physical Review 71, p. 212, 1947) for the isotope abundances in copper, which gave a ratio of 2.330 ± 0.032 and 2.277 ± 0.017, respectively. These values when corrected for the change in the zinc standards, give 2.163 for Ewald's measurements, and 2.092 for Duckworth and Hogg's. Our direct electrical comparison of the copper isotopes (Physical Review 72, p. 347, 1947) in connection with the study of meteoritic copper gave a ratio of 2.235 ± 0.010.

957 Report of Stable Isotopes, by W. E. Foster. AECD-2221 (Y-155), January 31, 1948, decl. August 9, 1948. 34p. Informal disposition.

An inventory is given reporting the stable isotopes produced by the electromagnetic process which are now available in milligram quantities to users within the Atomic Energy Commission.

ISOTOPES

958 On the Isotopic Composition of Meteoritic and Terrestrial Gallium, by Mark G. Inghram and David C. Hess, Jr., and Harrison S. Brown and Edward Goldberg. Physical Review 74, p. 343-344, August 1, 1948. (See also AECD-1974)

The abundance of the isotopes in a sample of gallium separated from a meteorite were found to be the same as in ordinary gallium within the experimental error. The ratio of the abundance of Ga^{69} to Ga^{71} was 1.509 for gallium from a meteoritic source; for gallium from a terrestrial source the ratio was 1.510.

959 Production of Radionuclides, by John W. Irvine, Jr. Nucleonics 3, No. 2, p. 5-16, August 1948.

A general discussion and review of the preparation of the important isotopes is given. The discussion contains a table summarizing the main types of nuclear reactions, a table of the radionuclides produced by the cyclotron, as well as a table of thermal neutron cross sections for 26 radionuclides. Curves are given for the excitation of sodium bromide, Co^{59}, Mg, Fe^{56}, by deuterons, and for thick target yields from deuterons on Mg and sodium bromide. Product purity problems as well as the problems connected with the preparation of targets and processing of product nuclides are discussed. 30 references.

ISOTOPES SEPARATION

960 Concentration of Copper 63 by the Countercurrent Electromigration Method, by Samuel L. Madorsky and Sidney Straus. Journal of Research of the National Bureau of Standards 41, p. 41-44, July 1948.

Concentration of Cu^{63} by the countercurrent electromigration method is described. The electromigration cell was operated with cupric sulfate as the electrolyte for periods of about 400 to 500 hours. A definite, though small, concentration of Cu^{63} in the cathode compartment of the cell was obtained. The terminal separation coefficient was about one third as large as that found for chlorine under similar conditions.

LABORATORIES

961 "Nucleonics" + Architecture → "Hot" Design, by A. D. Mackintosh. AECD-2178, June 9, 1948, decl. July 12, 1948. 6p. For publication in a technical journal.

A new specialized field of architecture has recently opened up which calls for a well founded background in nuclear physics and chemistry, as well as in architecture. This field embraces the design and construction of facilities for radioactive research, development, and operations. There is a great need for architects who can speak the language of the scientist as well as that of the engineer, in order to produce economically the most desirable laboratory and plant facilities for this important recent scientific development: work in the field of "nucleonics".

LABORATORIES

962 Radiobiological Research to Begin at Chicago. Chemical and Engineering News 26, p. 2380, August 9, 1948.

The Argonne National Laboratory is establishing a radiobiological experimental station at its new Du Page County site, 20 miles west of Chicago. At this station carbon 14 and other important tracer isotopes will be incorporated into living organisms, both plant and animal, in such a way that all of the constituent carbon, phosphorus, and sulfur compounds of the plants and animals will have a uniform specific concentration of the particular isotope.

MASS SPECTRA

963 Thirty Years of Mass Spectroscopy, by Arthur J. Dempster. Scientific Monthly 67, p. 145-153, September 1948.

A history of the development of mass spectroscopy is given, starting with the initial stage of exploration of the isotopic constitution of naturally occurring elements to the discovery of 540 different radioactive isotopes and the construction of the calutron in 1946. Bainbridge's velocity filter, double focusing, and Nier's mass spectrometer adapted recently for tracer work are emphasized as milestones in the development.

METALLURGY

964 Alloys for Use at High Temperature -- Report on Visit to Germany and Austria, by W. J. Robinson. New York, Mapleton House, 1947. 79 p.

965 Foundry Developments, by Edwin Bremer. Foundry 76, No. 9, p. 144, September 1948.

The level of molten metal in a cupola is determined by the use of radioactive isotopes. The isotope is mounted on a vertical slide rail alongside the cupola, on the opposite side of which a similar slide rail carries a Geiger Müller counter. As the radioactive source and the counter are moved up and down simultaneously, the intensity of gamma radiation reaching the counter varies according to whether the rays pass through the molten metal or the gas above it. The point at which the radiation count changes indicates the height of the surface level.

966 A Method for the Evaporation of Alloys, by Louis Harris and Benjamin M. Siegel. Journal of Applied Physics 19, p. 739-741, August 1948.

A method has been developed for the evaporation of alloys in high vacuum which from the nature of the procedure used should be applicable to all alloys which are not refractory. The method has been tested on α-brass and β-brass and on a gold-cadmium alloy. These alloys have components whose vapor pressures are very different and yet chemical and electron diffraction analyses on the evaporated brass alloys and chemical analysis on the evaporated cadmium-gold alloy show that the composition of the original alloy is held to within close limits.

METALLURGY

967 Nucleation, by J. C. Fisher, J. H. Hollomon, and D. Turnbull. Journal of Applied Physics 19, p. 775-784, August 1948.

Based on Turnbull's concept of the importance of transient nucleation during phase transformations in solids, a general theory of nucleation has been developed. The nucleation mechanism for reactions where stable nuclei appear only during cooling or plastic deformation has been clarified. The general theory makes possible quantitative description of the rates of nucleation of all phase transformations as well as of fracture cracks, slip bands, and magnetic transformations in solids.

968 Preparation and Properties of Pure Titanium, by I. E. Campbell, R. I. Jafee, J. M. Blocher, Jr., Joseph Gurland, and B. W. Gonser. Journal of the Electro-Chemical Society 93, p. 271-285, 1948.

By decomposing Ti iodides (formed by the actions of iodine vapor on the crude metal) on a hot filament, a ductile Ti of high purity is produced. A description is given of the construction and operation of glass units producing 300-600 grams of Ti per run in the form of rods of 0.3-0.4 inches in diameter. As deposited this metal has a hardness of about 90 Vickers, and it can be cold worked drastically by swaging or rolling. An investigation of working and mechanical properties was made.

969 Radioactive Tracers in Flotation, by A. M. Gaudin, P. L. de Bruyn, F. W. Bloecher, and C. S. Chang. Mining and Metallurgy 29, p. 432-435, August 1948.

The radioactive isotope C^{14} may be used to study flotation problems. The C^{14} is present in the flotation agent and may be detected by internal counting tubes, the carbon dioxide being allowed to form a part of the counter tube. A special method was developed, permitting quantitative recovery of CO_2 from the organic compound. The tracer study opens a wide field of research, such as measuring of surface areas, the dynamic properties of the mineral-agent bond formed, the preferential attachment of collector ions to a particular mineral surface, and the concentration of controlling ions in a flotation pulp.

970 A Study of Cerium-Magnesium Alloys (Étude des Alliages Cérium-Magnésium), by Francoise Mahn. Annales de Physique 3, p. 393-458, July-August 1948. (In French)

The equilibrium diagram of the cerium-magnesium system was thoroughly studied. Several important effects were noted. The density varies in continuous fashion from magnesium to cerium. The intermediate compounds cannot be detected from density measurements. It was found that Ce-Mg alloys are purely paramagnetic and that any ferromagnetic properties found in previous studies were due to traces of iron.

Compounds found were $CeMg_9$, $CeMg_3$, and CeMg. A small quantity of Mg(< 1 per cent) has a considerable influence on the allotropic transformation of cerium. The magnesium catalyzes the cerium γ to β conversion, modifies greatly the breadth of the hysteresis cycle and diminishes the dilatation cycle. The complete Ce-Mg equilibrium diagram is given, as is a table of densities, magnetic coefficients, magentic moments, and the Curie paramagnetic points. 59 references.

METALLURGY

971 Technical Definitions in Powder Metallurgy, by H. J. Bartels, W. Hotop, and R. Kieffer. Archiv für Metallkunde 1, p. 311-315, 1947.

This article gives the nomenclature used in powder metallurgy and presents a glossary of technical terms.

MINERAL RESOURCES

972 Minor Metals, by Allan F. Matthews. Washington, Government Printing Office, 1948. 19 p.

A portion of this pamphlet contains information on the location and uses of radium and mesothorium.

973 World Survey of Uranium, by John Niven. World Affairs 2, p. 187-196, April 1948.

NEUTRONS

974 Calculations for Use with the Fast Neutron Meter, by C. C. Gamertsfelder. AECD-2173 July 21, 1944, decl. July 29, 1948. 4p. Informal disposition.

In order to make the necessary calculations on tolerance dose and to determine the calibration of neutron meters, the energy of the neutrons, the composition of tissue and of gases in the ionization chambers, the cross sections of the various atoms involved, and the fraction of energy lost per collision must be known. The atoms involved were taken to be hydrogen, carbon, nitrogen, and oxygen. The tissue composition was assumed and the neutron cross section data for the atoms taken from the literature. The relation, $F(\text{lost}) = E\,\frac{2M}{(M+1)^2}$, where E is neutron energy in ev and M is mass of atom struck by neutron, was derived for the calculation of the energy lost per collision. The tolerance dose for neutrons was taken to be 0.02 rep (roentgen equivalent physical) where one rep is that amount of radiation which will lose 83 ergs per gram of tissue. A table was then calculated giving the numbers of neutrons incident per cm^2 that are equivalent to the tolerance dose, for neutron energies of 0.5, 1.0, 2.0, and 4.0 Mev.

The neutron meter was calibrated and consists, briefly, of two chambers filled with argon and methane, respectively, and mounted on boxes containing Lindemann electrometer systems.

975 Neutron Absorption Cross Sections of Radioactive La^{140} and Two Stable Cerium Isotopes, by S. Katcoff, J. A. Leary, K. A. Walsh, R. A. Elmer, S. S. Goldsmith, L. D. Hall, E. G. Newbury, J. J. Povelites, and J. S. Waddell. AECD-2174 (LADC-529), n.d., decl. July 29, 1948. 12p. For publication in Journal of Chemical Physics.

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Two multi-curie samples of 40h La^{140} were irradiated with slow neutrons at the Los Alamos homogeneous pile for 24 hours. The small amount of 3.7h La^{141} formed was allowed to decay to 28d Ce^{141} which was radiochemically extracted and counted. From the activity measured, the neutron flux, and the known half-lives, a value of 3.1 ± 1.0 barns was calculated for the cross section of 40h La^{140}. The thermal neutron absorption cross sections of stable Ce^{140} (88.5 per cent abundance) and Ce^{142} (11.1 per cent abundance) were also measured and found to be $0.27 \pm .06$ and $0.105 \pm .020$ barns, respectively, per atom of the naturally occurring element.

976 The Use of the Uranium Reactor in Radiochemical Studies, by R. T. Overman and J. A. Swartout. AECD-2181, n.d., decl. July 7, 1948. 1p. For oral presentation before the American Chemical Society Symposium on Nuclear Reactions to be held in Portland, Oregon, September 13-17, 1948. Also for publication in a technical journal.

This document is an abstract and is reproduced here in its entirety.

Because of the variety of radiations existent in a graphite moderated, natural-uranium reactor, a number of nuclear reactions may be anticipated. In addition to neutrons of a wide range of energy appreciable fluxes of radiations resulting directly or indirectly from the fission process are present. Because of the geometry of the "pile" the relative intensities of the various radiations vary with position. In the case of neutron reactions, those induced by neutrons of thermal energy predominate: included are radiative capture, fission, and, in the case of lower atomic weight elements, capture followed by proton or alpha-particle emission. A study of (n,p) reactions in elements of moderate atomic weight has been made possible by exposure of the target element in localized regions of increased fast neutron flux.

Specific examples of neutron induced reactions and the problems attendant their study are discussed, including (1) determination of thermal neutron flux, (2) chemical identification of the reaction products, and (3) characterization of the radiations associated with the products.

977 Scattering and Absorption of Neutrons by Polarized Nuclei, by M. E. Rose. AECD-2183 (ORNL-72), June 22, 1948, decl. July 27, 1948. 21p. For use in lectures and seminars and for publication in a technical journal.

It is the purpose of this study to examine, from the theoretical point of view, certain experiments which it is possible to perform with polarized neutron beams incident on polarized nuclei. The following are considered: (a) coherent and incoherent scattering in a crystal taking into account elastic scattering only, (b) scattering and absorption at higher energies where diffraction effects are not present and only a single nucleus need be considered, (c) the determination of angular momenta of levels of compound nuclei, and (d) the process of polarization of resonance neutrons by polarized absorbers.

An attempt has been made to ascertain what nuclear information can be obtained from the manner in which various effects depend on the polarization of nuclei and neutrons.

NEUTRONS

978 The Reaction He^3 (n,p)H^3 Induced by Thermal Neutrons, by J. H. Coon, M. Goldblatt, Ralph Nobles, and C. F. Robinson. AECD-2190 (LADC-462), n.d., decl. July 30, 1948, 3p. For publication as a Letter to the Editor of Physical Review.

The cross section for the reaction $He^3 + n = H^3 + H^1 + .75$ Mev was measured by counting the ionization pulses arising from the disintegration products. Since the reaction $N^{14}(n,p)C^{14}$ yields protons of closely the same range as the reaction studied, the counting efficiency will be nearly the same for the two cases. Therefore, the ratio of the counting rates gives the ratio of the disintegration cross sections, if the ratio of the number of atoms is taken into account. Using the known value of 1.75×10^{-24} cm^2 for the absorption cross section of nitrogen as determined by Lichtenberger, Fowler, and Wattenberg, these data give $\sigma = 7{,}500 \pm 20\% \times 10^{-24}$ cm^2. A modification of the above measurement used calibrated indium foils in the place of the nitrogen. The cross section for the reaction in question is then given by $\sigma = \frac{c}{nvN}$ where c is the number of disintegrations per second occurring within the effective active volume of the counter, N is the number of atoms in that volume, and nv is the absolute thermal neutron flux density in the region of the counter. These data gave a value $\sigma = (7{,}400 \pm 20\%) \times 10^{-24}$ cm^2.

979 Upper Limits of the Fission Cross Section of Bismuth, Lead, Mercury, Gold, Iridium and Tungsten for 14 Mev Neutrons, by Anne A. Phillips, Louis Rosen, and R. F. Taschek. AECD-2196 (LADC-512; LADC-513), March 16, 1948, decl. July 19, 1948. 11p. For publication in Physical Review.

A photographic technique was utilized to establish precise upper limits for the fission cross sections of various naturally-occurring heavy elements below radium, when these are bombarded by 14 Mev neutrons. The experimental method consisted of placing thin foils of the elements to be investigated in contact with Eastman special fission plates (emulsion #333,202) and exposing the combination to the 14 Mev neutron flux. The neutron intensity was monitored by two other fission plates in contact with thin foils of U^{238}.

The deduced fission cross sections for the elements investigated are given in the table below:

Element	Cross Section in cm^2
Bi	$\leq 1.4 \times 10^{-29}$
Pb (normal isotopic abundance)	$\leq 2.6 \times 10^{-29}$
Hg	$\leq 6.7 \times 10^{-30}$
Au	$\leq 1.2 \times 10^{-29}$
W	$\leq 1.5 \times 10^{-29}$
Ir	$\leq 1.2 \times 10^{-29}$

980 Compact Neutron Source. Chemistry 21, p. 43, July 1948. (U. S. Patent No. 2, 440,999.)

Finely powdered beryllium metal is mixed with a solution of radium bromide which has been freed of radioactive decomposition products by boiling. The mixture is formed into a cylindrical pellet, slightly more than three-tenths inch in both height and diameter, in a press capable of applying pressure above ten tons per square inch. This pellet, tightly sealed in a brass cylinder, becomes the source of the desired neutrons.

NEUTRONS

981 Contemporary Neutron Physics, by Arthur H. Snell. Science 108, p. 167-176, August 20, 1948.

This is a review article which briefly discusses the following: neutron cross sections, neutron spectrometry, scattering resonances, slowing down and diffusion of neutrons, magnetic properties of neutrons, neutron polarization, search for specific interaction between neutrons and electrons, delayed neutrons, neutrons in the atmosphere, consequences of the wave properties of neutrons, radioactive decay of the neutrons. 26 references.

982 Neutron Absorption in Samarium, by A. J. Dempster. Physical Review 74, p. 505, August 15, 1948. (See also MDDC-1419)

Mass spectra were taken of normal samarium and of samarium with isotope 149 reduced so that it could not be detected. Two sample spectra are shown, and it is seen that the isotopes that disappear at mass 149 reappear at mass 150. No changes occurred in isotopes 147, 148, 152, and 154 as a result of neutron absorption.

983 The Neutron Density in the Free Atmosphere up to 67,000 feet, by Luke C. L. Yuan. Physical Review 74, p. 504-505, August 15, 1948.

Two BF_3 filled proportional counters, one cadmium shielded and one tin shielded, were sent up to 67,000 ft. The neutron counting rate is plotted as a function of altitude for both counters, and a maximum is obtained for both counters at about 7 cm Hg. The maximum for slow neutrons is at 9 cm Hg. The intensity increases exponentially with altitude up to 18 cm Hg, and the results agree with previous measurements at lower altitudes. A plot is made of the absolute rate of production as a function of pressure.

984 Production of Neutrons by the Capture of Cosmic-Ray Mesons at Sea Level, by Gerhart Groetzinger and Gordon W. McClure. Physical Review 74, p. 341-342, August 1, 1948.

An attempt was made to obtain information concerning the capture of mesons at sea level by searching for neutrons emitted during this process. By using materials of high atomic weight, fission induced by slow mesons can be detected in this way. The apparatus consists of a fourfold coincidence counter telescope in which the incident mesons are deflected in magnetized iron plates. The results obtained are inconclusive; further work is in progress.

985 Phase of Scattering of Thermal Neutrons by Titanium, by S. S. Sidhu, L. Winsberg, and D. Meneghetti. Physical Review 74, p. 222, July 15, 1948. (See also AECD-1948).

From the neutron diffraction pattern of TiC obtained with a rotating shutter mechanism it was determined that scattering of neutrons by titanium nuclei is in the phase opposite from that of the incident neutron wave. The same is true for H, Li, and Mn nuclei.

NEUTRONS

986 Properties of a Hypothetical Di-neutron, by N. Feather. Nature 162, p. 213, August 7, 1948.

It is pointed out that He^6 is unstable against the emission of a di-neutron. The upper limit to the binding energy of this particle is calculated to be (.7 ± .2 Mev), and the predicted life-time, on the assumption that the transition $n^2 \underset{\sim}{\beta} H^2$ is superallowed, is $1<\tau<5$ secs. Possible methods of detecting a di-neutron are suggested. Thus, certain nuclear transformations may be expected to be produced.

987 Resonances in $Li^7(p,n)Be^7$, by G. Breit and I. Bloch. Physical Review 74, p. 397-404, August 15, 1948.

A qualitative and schematic discussion of the theory of the angular distribution of neutrons emitted in the reaction $Li^7(p,n)Be^7$ is presented. Evidence concerning existence of quasi-stationary states is discussed with the conclusion that there are indications of two such states, one at ∿2.2 Mev incident proton energy and another below the reaction threshold. Both levels are probably of odd parity. The existence of the level below threshold is based on less direct evidence than that of the level at ∿2.2 Mev. It is assumed that Be^7 is left either in its ground state or another state of the same parity.

988 Resonances in the Process $S^{32}(n,p)P^{32}$, by E. Bleuler. Helvetica Physica Acta 20, p. 519-524, 1947. (In German).

The P^{32} activity induced in S was studied as a function of neutron energy between 2 and 317 Mev using monochromatic neutrons of various energies obtained from the D + D reaction with a thin target. Resonances were found at 2.80, 3.10, 3.46 and 3.65-3.7 Mev.

989 The Slow Neutron Cross Section of H, by W. B. Jones, Jr. Physical Review 74, p. 364-369, August 15, 1948.

The total neutron cross section of water has been measured with a slow neutron velocity spectrometer in the energy interval 0.003 to 100 ev. A treatment of the data for energies above 0.8 ev have a value of 20.0×10^{-24} cm^2 for the free neutron-proton cross section. Measurements of the total cross section of cyclohexane in the energy interval 0.8 to 100 ev were also made, and from these data a value of 20.1×10^{-24} cm^2 was obtained for the free neutron-proton cross section. Measurements of the oxygen and carbon cross sections were made in order that the data on water and cyclohexane could be corrected to obtain the bound proton cross section. The values obtained for these cross sections for the high energy neutrons are: for oxygen 3.7×10^{-24} cm^2, and for carbon, 4.7×10^{-24} cm^2. The data on water for energies below 0.8 ev yield evidence for the existence a of cross section for inelastic scattering of neutrons by water.

NUCLEAR PHYSICS - METHODS OF MEASURING

990 Progress Report on the Determination of Alpha Emitters in Air, by R. H. Firminhac and A. Pfanstiehl. AECD-2191 (CN-2531), January 4, 1945, decl. August 2, 1948. 19 p. Informal disposition.

An electrostatic precipitator and a newly developed filter paper are compared for efficiency, reliability, availability, and ease of use. The aerosols collected in either case are counted for alpha activity in a cylindrical pulse chamber, the design of which is an adaptation of the breech-locking air alpha-chamber. Vapor and gases are not collected by either the precipitator or the filter paper unless occluded on particulate matter. Comparison tests were made; the experimental procedures and data collected are given in the report.

991 Statistical Error in Absorption Experiments, by M. E. Rose and M. M. Shapiro. AECD-2197 (ORNL-52), May 10, 1948, decl. July 13, 1948. 33 p. For publication in Physical Review

There are many physical measurements of absorption or transmission of radiation in which the transmission is an exponential function of the absorber thickness. Measurements of this kind occur, for example, in the fields of optics, X-rays, and nuclear physics. In the latter field the purpose is usually to determine a total cross section.

In certain exponential absorption experiments, notably measurements of cross sections by transmission, it is important to achieve minimum statistical error in a limited time, or to minimize the counting time required to measure the absorption coefficient with a preassigned accuracy. The conditions required to attain these ends, i.e., the geometry for optimum transmission and the best apportionment of counting times among the incident and transmitted beams and background, have been investigated for a wide range of relative backgrounds (10^{-3} to 10^{2}) and for two geometries: I. Beam area fixed, absorber thickness alone is varied. II. Beam area and absorber thickness are both disposable parameters, while the total amount of absorber intercepting the beam remains fixed. In both cases the incident flux density and the background rate are assumed constant. The optimum transmissions are shown to be, in general, considerably smaller than those commonly used in absorption experiments. Thus, in Case 1, a useful rule to employ a transmission of about 0.1 for low backgrounds, 0.2 for moderate backgrounds, and 0.3 for high backgrounds. The following have also been determined: (a) minimum statistical error for a given total counting time; (b) statistical error and the best distribution of counting times for non-optimum geometry; (c) sensitivity of the accuracy or total counting time to deviations from optimum transmission.

992 Physics Division Quarterly Report, February 1, 1948 to May 1, 1948. Part 1. General Physics Research. Section 5. Solid Counters: Scintillation Counters, by Louis Wouters. AECD-2203 (UCRL-116), June 30, 1948, decl. August 5, 1948. 15 p. Informal disposition. This also includes declassification of the scintillation counter. Document for sale by AEC. (See also abstract No. 995).

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NUCLEAR PHYSICS - METHODS OF MEASURING

(Continued from preceding page)

In the early phases of nuclear research, scintillation counters proved valuable for detection of alpha particles. In this technique, scintillations produced by the excitation of fluorescent and phosphorescent screens were observed visually. The method has been revived in modern form with the use of photomultiplier tubes for the observation of light pulses, and large, transparent crystals for the conversion of as much of the energy of a penetrating particle into light as possible. On the basis of reported efficiency and response time, the work described in this paper was initiated using naphthalene. The first experimental arrangement consisted of a 1P21 photomultiplier tube mounted in a glass container stuffed with moth flakes and immersed in liquid air. With a radium gamma-ray source, a ratio of about 20 was observed between the counting rate of this set-up as compared with that of the photomultiplier surface alone exposed to the gamma radiation under otherwise identical conditions.

As a consequence of the sensitivity (about 10 per cent gamma-counting efficiency) of this rather crude and inelegant device, as well as of its simplicity, a program was undertaken with the aim of devising a rugged and adaptable basic counter unit. This program received added impetus when it was discovered that the much greater usable light output of anthracene made possible the elimination of the refrigerant. With respect to pulse width, it was found that a condition exists whereby the minimum, independently observed pulse width coincides with the maximum resolution of simple, fairly conventional electronic recording equipment. Such apparatus does not presently exist in useful quantity; however, it is feasible and economically advantageous to construct adapter units, containing fast discriminator, coincidence and pre-scaler stages, that would permit use of the greater part of existing scaling equipment.

Detection materials, the crystallization of anthracene, optical systems, the photomultiplier tube, pulse and noise characteristics of the overall detector, high gain photomultiplier operation, the pre-amplifier, the counting equipment and applications of scintillation counters are discussed.

993 Excitation Time of Silver-Activated Zinc Sulfide on Electron Bombardment, by J. F. Mullaney, F. Reines, and H. G. Weiss. Physical Review 74, p. 491-492, August 15, 1948.

The excitation by 4-Kev electrons of a Dumont 5JP11 phosphor (silver-activated zinc sulfide) was studied, and the rise time was found to be less than 10^{-8}sec. The equipment is described and the delay accurately determined. It is shown that the light emission delay in the phosphor is not observable to within the resolving time of the measuring technique (10^{-8}sec.)

994 On the Use of Nuclear Plates in a Magnetic Field, by Ian G. Barbour. Physical Review 74, p. 507, August 15, 1948.

The application of various magnetic deflection methods in the study of cosmic rays is discussed. The author used very thin emulsion-coated glass plates, stacked so that several curvature measurements could be made on the same particle in crossing successive air gaps. A projection microscope, tilting stage for measuring dip angles, and a magnifying pantagraph attached to the stage were used to simplify the procedure. Good matching was obtained with proton tracks from the cyclotron and with rays from balloon flights.

NUCLEAR PHYSICS - METHODS OF MEASURING

995 Pulse Characteristics of Anthracene Scintillation Counters, by Louis F. Wouters. Physical Review 74, p. 489-490, August 15, 1948. (See also Abstract No. 992.)

Experiments with regard to the superiority of anthracene for scintillation counters have been confirmed. In a representative arrangement, a transparent piece of this material was fastened to the wall of a 1P21 photo-multiplier, facing the photosensitive surface. When operating at room temperature at 70 volts per stage and upon exposure to a standard radium source, individual pulses up to 0.5-volt height (corresponding to the emission of about 100 electrons at the photo-surface) were observed at the output. The signal-to-noise ratio of about 5:1 remains essentially constant up to 120 volts per stage applied to the first two stages of the 1P21, beyond which voltage it falls rapidly; it is independent of the potential applied to the ramaining seven stages. An over-all gain of 25 million is then achieved by operating stages one and two at 120 volts each, and stages three through nine at 160 volts each. Pulse heights of 20 volts and more are then observed, which are sufficient to feed directly into oscilloscopes, coincidence, mixers, etc., without recourse to additional vacuum-tube amplification.

996 Variations in Total Counts of P^{32} and I^{131} for Dishes of Different Atomic Number by Russell F. Cowing and Egilda DeAmicis. Science 108, p. 187, August 20, 1948.

Radioactive phosphorus emitting beta rays with a maximum energy of 1.7 Mev was evaporated to dryness on filter paper, Al, Cu, Sn, and Pb dishes, the amount of radioactive material being contained within a circle of about 1 cm in diameter. Measurements were made at a distance of 10 cm with a Geiger counter tube, the glass wall of which was 0.12 mm thick. The percentage reflection using paper as zero reflector increased with the atomic number of the various materials. Identical technique was followed for I^{131}, which emits beta rays with a maximum energy of 0.7 Mev and gamma rays with a maximum energy of 0.4 Mev. The results obtained from these experiments show that the percentage reflection from the various dishes bears linear relation to the atomic number of the reflecting material when filter paper is used as a nonreflecting material. From this work it may be concluded that the amount of radioactivity as reported will vary considerably according to the type of dish used.

NUCLEAR PROPERTIES

997 Nuclear Isomeric Transitions of Short Periods, by P. B. Treacy, Nature 162, p. 186-187, July 31, 1948.

Copper, molybdenum, silver, cadmium, indium, and lead were irradiated within Geiger-Müller counters by a pulsed beam of X rays. The mean current during the pulse was approximately 15 m.amp. and the pulse width 5μsec. No evidence of activity was obtained. Details of experimental arrangements are given.

NUCLEAR PROPERTIES

998 Nuclear Spins of the Carbon Isotopes, by F. A. Jenkins. Physical Review 74, p. 355-363, August 15, 1948.

High dispersion spectrograms of the Swan bands of diatomic carbon are obtained from samples enriched to 50 percent and 40 percent, respectively, in C^{13} and C^{14}. The method of exciting an intense spectrum with microgram samples is described. To permit measurements of the alternating-intensity ratio, current densities in the source had to be limited so that the A-type doublets were well resolved. For C^{13}, photometric measurements of this ratio give 3 : 1, showing that the nuclear spin I = 1/2. The antisymmetric rotational levels have the higher statistical weight (Fermi-Dirac statistics). For C^{14}, only the lines from symmetric levels appear. This shows clearly the I = 0 for C^{14}, and that the nucleus obeys Einstein-Bose statistics. Wave numbers are given of lines in the R branches of the 0,0 band in the range K = 12 to 20, due to all molecular species containing C^{12}, C^{13} and C^{14}. An isotope effect in the splittings of the electronic triplets is investigated, and found to agree with that calculated from the general term formula for $^3\Pi$ states.

NUCLEAR THEORY

999 Disintegration of Mesotrons in B^{10}, by Norris G. Nereson. Physical Review 74, p. 509, August 15, 1948.

This letter to the editor is based upon AECD-2098. AECD-2098 was listed in Vol. 1, No. 3 of this journal as Abstract 510.

1000 Mean Life of Negative Mesons in Carbon, by C. W. Kissinger and D. Cooper. Physical Review 74, p. 349-350, August 1, 1948.

Measurements are being made of the separate lifetimes of negative and positive mesons in graphite. Seventy-one positive decays and 62 negative decays in carbon have been observed, of which about six of each sign are caused by accidentals. Calculations of the average decay time gave 2.16 and 2.25 ± 0.20 microseconds for the mean life of the positive and negative mesons, respectively. These mean lives are consistent with the accepted value of about 2.2 microseconds for the decay of positive mesons in all materials.

The life time and yield results for carbon indicate that few, if any, of the negative mesons undergo nuclear capture in this element. The authors conclude that a difference of 6% is to be expected in the mean life and relative yields of positive and negative mesons in carbon.

1001 The Mean Life of Negative Mesotrons in Sulfur, by Harold K. Ticho. Physical Review 74, p. 492, August 15, 1948.

The mean lives of positive and negative mesotrons stopped in sulfur were measured separately. The mean life of the positive disintegration electrons observed was 2.04 ± 0.23 μ seconds; for negative disintegration electrons it was 0.54 ± 0.12 μ seconds. Thus the ratio of mean lives in sulfur, τ_+/τ_- is 4.0 ± 0.7.

NUCLEAR THEORY

1002 On the Production of Mesons by Nucleon-Nucleon Collisions, by C. Morette and H. W. Peng. Proceedings of the Royal Irish Academy 51 A, p. 217-237, February 1948.

The cross-sections are found for $v/c \gg 1$ where v is the velocity of the incident nucleon, using radiation damping theory to calculate matrix elements. In the calculations the meson mass is assumed small and small terms in the damping equation are neglected. The solution is exact within these limitations. A charge-symmetric mixed meson theory is used. With the energy of the incident nucleon the cross-section increases fairly rapidly, while the distribution of mesons over their energy range is fairly uniform.

1003 On the Range of the Electrons in Meson Decay, by J. Steinberger. Physical Review 74, p 500-501, August 15, 1948.

Experiments were carried out to determine the range of electrons resulting from meson decay, by measuring the rate of occurrence of delayed coincidences as a function of absorber thickness. The results are shown in a graph, and it is seen that most electrons have an energy of $\sim$25 Mev, but an appreciable number have larger energy. It is concluded that the spectrum of decay electrons is very complex and that the possibility that the mesons decay via two competing processes should not be overlooked.

1004 Phenomenological Theory of Exchange Currents in Nuclei, by R. G. Sachs. Physical Review 74, p. 433-441, August 15, 1948.

On the assumption that the interaction between nuclear particles involves a space exchange operator, it is shown that an addition must be made to the conventional current density for the nucleons in order to establish the equation of continuity within the nucleus. A general expression is found for this exchange magnetic moment. This phenomenological theory has application to the calculation of magnetic moments of nuclei and to the calculation of transition probabilities for the absorption and emission of radiation by nuclei. In this paper, application is limited to the exchange moments of H^3 and He^3. It is found that the exchange moments are six or seven times too small to account for the observed moments. In view of results obtained by Villars (Physical Review 72, p. 256, 1947), it is concluded that the important contributions to the magnetic moment are directly related to the properties of the field (meson field) which describes the nuclear interaction, so the exchange moment may be of use for obtaining direct information concerning the nature of this field.

1005 Production and Annililation of Negative Protons, Part II, by J. McConnell. Journal of the Proceedings of the Royal Irish Academy 51 A, p. 173-190, October 1947.

The production of negative protons by the collision of two charged mesons is studied using the M-R meson theory. The production of meson-nuclear collisions is discussed. This process occurs only when the energy of the meson is at least 4×10^9 Ev. With increasing energy the value of the cross-section rises rapidly from zero to a maximum value of 3.5×10^{-29} cm^2 for an energy of

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NUCLEAR THEORY

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2×10^{10} Ev, and then slowly decreases to an asymptotic value of 3×10^{-29} cm^2. The possibility of detecting negative protons in cosmic ray experiments is considered.

NUCLEAR TRANSFORMATION

1006 The Cross Section for the Reaction d(He^3,α)p, by C. P. Baker, M. G. Holloway, L. D. P. King, and R. E. Schreiber. AECD-2189 (LADC-541), June 28, 1943, decl. August 4, 1948. 57 p. Informal disposition.

This is a final report on the measurements made of the cross section for the reaction d(He^3,α)p for incident energies of the He^3 ion between 0.6 Mev and 1.3 Mev. Fundamentally, this measurement consists of bombarding a known number of target particles (deuterons) with a known number of He^3 particles and observing the number of disintegration alpha particles which appear in a known solid angle.

Measurements of the cross section for the reaction d(He^3,α)p have been made, using a target about 0.55 Mev thick. The thick target cross section is about 0.25 barn at 0.35 Mev, rising to 0.6 barn at 0.75 Mev and dropping to 0.5 barn at 1.07 Mev. Corrections to the cross section for the effect of thick target and inhomogeneity of the beam give a cross section curve which rises from about zero at 0.3 Mev to 0.8 barn at 0.65 Mev and drops to 0.5 barn at 1.0 Mev. The above cross section values were obtained from measurements in a cone of approximately 45° about the direction of the beam. Additional measurements at right angles to the beam indicate that anisotropy exists in the center of mass system. 1 barn = 10^{-24} cm^2.

1007 Nuclear Reactions in Antimony with High Energy Particles, by Manfred Lindner. AECD-2192 (UCRL-143), n.d., decl. August 6, 1948. 103 p. For use as a thesis.

Thirty-six radioactive species have been identified as products of the spallation of antimony irradiated with high-energy particles produced in the 184-inch cyclotron at the University of California Radiation Laboratory in Berkeley. The manner in which the yields change with change in the energy of the bombarding particle was also investigated. A simple mechanism has been proposed which incorporates the concept of binding energy of neutrons, protons, and alpha particles. This mechanism leads to conclusions in satisfactory agreement with the observed results.

The radiation characteristics of nine new radioactive species are described in detail. These include two tellurium, one antimony, two tin, two palladium and two rhodium activities.

The subject matter covered is principally concerned with the identification of those products which result from the irradiation of elements in the region of atomic number 50-51 with deuterons and helium ions produced in the 184-inch cyclotron. In this region of the periodic table, the mass defect curve is near its minimum, i.e., the nuclei of elements in this region are more stable with respect to their individual nucleons than elements in any other section of the periodic table. It is to be expected, therefore, that disintegration products should differ in degree, if not in kind, from those produced by these same beams on nuclei representative of other regions of the periodic system. A study of such disintegration products and their mode of formation may therefore serve to aid in the understanding of the forces occurring within the nucleus. 28 references.

NUCLEAR TRANSFORMATION

1008 High Energy Spallation Products of Copper, by Daniel R. Miller. AECD-2193 (UCRL-142), July 1, 1948, decl. August 6, 1948. 53 p. For use as a thesis.

About twenty-five radioisotopes, belonging to eleven different chemical elements, have been identified as products of the reaction of 190 Mev deuterons with natural copper; the reaction of high-energy helium ions with copper has also been investigated. The chemical procedures by which the elements were isolated and purified are presented. The observed yields of the various products are discussed with respect to the possible modes of excitation of the target nuclei and the manner by which the excited nuclei might dissipate their energy.

Two previously unreported isotopes have been observed in the course of this work: Zn^{62}, decaying by orbital electron capture with a 9.5-hour half-life; and Fe^{52}, decaying by positron emission with a 7.8-hour half-life. 18 references.

1009 The Fission of Thorium with Alpha Particles, by Amos S. Newton. AECD-2194 (UCRL-83), April 15, 1948, decl. August 2, 1948. 33 p. For publication in Physical Review.

The fission distribution of thorium with alpha particles of average energy 37.5 Mev was measured by the chemical isolation method. The distribution found shows that the characteristic dip in the fission-yield mass-spectrum has been raised to within a factor of two of the peaks, compared to a factor of 600 in slow neutron fission of U^{235}. The raise in the dip has caused a corresponding lowering in fission yield of those elements at the peaks. The cross section for fission of thorium with 37.5 Mev alpha particles was found to be about 0.6 barn, and the threshold for fission was found to be 23 to 24 Mev.

1010 Low-Energy Cross Section of the D-T Reaction and Angular Distribution of the Alpha Particles Emitted, by E. Bretscher and A. P. French. AECD-2211 (LADC-537), November 15, 1946, decl. August 4, 1948. 30 p. Informal disposition.

The thick-target yield of the reaction, $T + D \rightarrow \alpha + n + 17.6$ Mev, has been measured, using a heavy-ice target, and observations have been made on the angular distribution of the alpha particles. Experiments have been conducted in the region 15 Kev incident triton energy. Within this range the angular distribution appears to be isotropic in the center-of-gravity system. The cross section for the reaction as a function of energy has been evaluated from the thick-target yield measurements. It appears to rise more rapidly with energy than is required by a simple Gamow function.

The values given for the cross section as a function of energy should, however, be accepted with reserve, because of the very great uncertainty involved in estimating the rate of energy loss of the bombarding tritons in the heavy-ice target. The values of thick-target yields are considered to be fairly reliable.

NUCLEAR TRANSFORMATION

1011 On the Inverse Reactions $H^3(p,n)He^3$ and $He^3(n,p)H^3$, by Louis Goldstein. AECD-2222 (LADC-539), December 16, 1947, decl. August 1948. 18 p. For publication in Physical Review.

It is shown that these two reversible reactions, at corresponding energies, may be of particular interest in the experimental verification of the general quantum mechanical cross-section ratio formula,

$$\frac{\sigma_{if}}{\sigma_{fi}} = \frac{p_f^2}{p_i^2}$$

p_f and p_i denoting the relative linear momenta of the particles produced in the $i \rightarrow f$ and $f \rightarrow i$ reactions, respectively. In the present case,

$$\frac{\sigma\left[H^3(p,n)He^3\right]}{\sigma\left[He^3(n,p)H^3\right]} = \frac{p_n^2}{p_p^2}$$

p_n and p_p being the relative linear momenta of the neutron and proton produced in these reactions, at corresponding energies.

Some of the properties of the highly excited He^4 nuclei likely to be involved in these reactions are described. It is shown that capture of slow protons and slow neutrons is in principle possible by the H^3 and He^3 nuclei and should be looked for by means of the gamma radiation which should accompany these capture processes. The large thermal neutron cross-section of the $He^3(n,p)H^3$ process observed recently in some preliminary experiments seems to constitute a qualitative verification of the preceding cross-section ratio formula.

1012 Photodisintegration of the Deuteron, by R. Wilson, C. H. Collie, and H. Halban. Nature 162, p. 185-186, July 31, 1948.

An accurate measurement of the cross section for the photodisintegration of deuteron into proton and neutron was made to check the theoretical value of between 13 and 17 x 10^{-28} cm^2. The measurement was made by using radiothorium as the source and by using an ionization chamber filled with deuterium to a pressure of six atmospheres. The gamma-ray flux, sensitive volume of the ionization chamber, pressure in the ionization chamber, and the gas purity were accurately known. The final result is $\sigma = (16.2 \pm 1.0) \times 10^{-28}$ cm^2. This compares with theoretical calculations as follows.

Theory	Assumed meson mass	$\sigma \times 10^{28}$
Moeller-Rosenfeld	197	15.1
Neutral	197	16.8
Moeller-Rosenfeld	296	13.3
Neutral	296	13.7

NUCLEAR TRANSFORMATION

1013 Production of Li^8 in Boron-Loaded Photographic Emulsions, by E. Pickup. Physical Review 74, p. 495, August 15, 1948.

Some boron-loaded, photographic emulsions were exposed to neutrons from a Li target bombarded with 600 kv deuterons. A mosaic of four microphotographs is shown, and indicates clearly the recoil Li^8 nucleus together with the α-particle from the B^{11} disintegration, as well as α-particles produced by Be^8 nucleus splitting. This is an example of the "hammer tracks" observed in cosmic ray stars. The total incident neutron energy indicates its being a neutron from the high energy end of the Li-D spectrum. An example of a star showing a "hammer track" out of some 500 cosmic ray stars was observed by the authors, the estimated Li^8 nucleus energy being 16 Mev, and the α-particle pair energy being 3 Mev.

1014 Products of High Energy Deuteron and Helium Ion Bombardments of Copper, by D. R. Miller, R. C. Thompson, and B. B. Cunningham. Physical Review 74, p. 347-348, August 1, 1948. (See also AECD-1976).

The identity and relative yields of about twenty of the radioisotopes produced by the bombardment of natural copper with 190 Mev deuterons and 380 Mev helium ions have been determined. Two previously unreported isotopes were detected: Zn^{62}, decaying by orbital electron capture with a 9.5-hour half-life, and Fe^{52}, decaying by positron emission with a 7.8-hour half-life. A table listing the various isotopes observed is given.

1015 Reaction Constants for $Li^7(p,n)Be^7$, by Richard Taschek and Arthur Hemmendinger. Physical Review 74, p. 373-385, August 15, 1948. (See also AECD-1820).

The exact nature of the reactions

$$Li^7 + p \rightarrow Be^7 + n + Q; \text{ and}$$

$$Be^7 + e^K \rightarrow Li^{7*} + \eta_o \rightarrow Li^7 + h\nu + \eta_o \text{ (about 10 per cent)}$$

$$\searrow\ Li^7 + \eta_o \text{ (about 90 per cent)}$$

was studied, using a Van de Graff generator and metallic lithium targets which had been evaporated onto tantalum caps. The values of the reaction cross section were determined for proton energies between 1.86 Mev and 2.5 Mev by comparison of the total neutron flux with that from a standardized RaBe source. An energy-angle nomograph is given for the reaction, as are graphs of cross sections and neutron yields as a function of proton energies. Graphs of angular distributions and their analyses are presented.

NUCLEAR TRANSFORMATION

1016 Relative Yields of Some X-Ray Induced Nuclear Reaction, by M. L. Perlman and G. Friedlander. Physical Review 74, p. 442-448, August 15, 1948.

X rays from the 100-Mev betatron and 80-Mev synchrotron were used to induce (γ,n), (γ,p), (γ,2n) reactions. Relative yields for a number of these reactions were determined by measurement of the activities of the products. Yields of (γ,n) reactions appear to be about an order of magnitude larger for $Z \geq 29$ than for lower Z; the transition seems to be abrupt. The five (γ,p) reactions studied have approximately equal yields, and these are about the same as (γ,n) yields below the transition. Values for the few (γ,2p) yields measured are about one-twentieth those for the (γ,p) reactions. Yields for the (γ,2n) reactions vary, but are much smaller than (γ,n) yields. The most probable number of particles emitted as the result of the interaction of a high energy quantum with a nucleus is one.

PARTICLE ACCELERATORS

1017 Physical Considerations Concerning the Design of the Bevatron, by Lloyd Smith. AECD-2200 (UCRL-129), June 21, 1948, decl. August 5, 1948. 26 p. Informal disposition. Document for sale by AEC.

Plans are now being developed for magnetic resonance accelerators, here called the bevatron which are to produce protons of energies up to 10 Bev. The feasibility of obtaining such tools for investigating the fundamental properties of matter has been established since 1945, thanks to the discovery of the so-called synchrotron principle and its successful application to smaller machines. In this article the principles from which the bevatron is to be constructed are discussed. A cycle of operation of an ideal machine is traced in some detail. The question of whether a real machine can be constructed which will approximate the ideal case closely enough is then considered.

The operation of the bevatron follows the basic requirements of an ultra-high energy accelerator. There are, in a broad sense, two of these. First, there must be a means of supplying energy to the particles in many small steps, since the voltages available in the laboratory are much smaller than the final energies sought. Second, there must be a means of guiding the particles surely and precisely over the path they must follow while acquiring their energy. The operating cycle, injection, specifications, behavior or ions during acceleration, removal of the beam, practical considerations, gas scattering, missing the injector, frequency tracking, asymmetries in the field, shape of field, relative dimensions of the chamber, and shielding are considered.

1018 A Process Aiding the Capture of Electrons Injected into a Betatron, by D. W. Kerst. Physical Review 74, p. 503-504, August 15, 1948.

The orbit contraction due to withdrawal of the electromagnetic energy from the kinetic energy of the electron beam after it leaves the injector is discussed. Injection from a gun placed at a radius smaller than the orbital radius, or the use of an "orbit contractor" consisting of one wire above and one wire below the orbit in which a rising current at injection time contracts the orbit, aids electron capture. A description of the "orbit contractor" is in process of publication by G. D. Adams.

PARTICLE ACCELERATORS

1019 **Synchrotron Project, Progress Report May 1, 1948. Purdue University, Technical Report No. 1. 15 p.**

An electron accelerator of the synchrotron type will be constructed capable of providing high energy particles above the 100 Mev range. Brief descriptions are given of its components.

PHYSICS, GENERAL

1020 Calculation On Atomic Weights, by S. Meyer. Acta Physica Austriaca 1, p. 120-128, 1947. (In German).

An empirical formula for calculating atomic weights is presented. In an atom of mass number, M, containing in its nucleus N neutrons and Z protons, then N-Z = J = M-2Z. The packing effect $\Delta = a(M - 1) - bJ^2$ has been computed using two sets of values for a and b. Chemical and mass spectral data are compared with the computed values.

1021 Deposit of Polonium on Mercury, by C. Chamie and M. Haissinsky. Journal de Chimie Physique 44, p. 197-198, 1947.

A study of the effects of pH, time of contact and of agitation was made; it is concluded that polonium in solution as ions but not in the colloidal state is absorbed by metallic mercury. Because polonium adsorbed on mercury is not readily released at either low or high pH, a distribution equilibrium is not involved.

1022 A Dynamic Method for the Determination of the Velocity Distribution of Thermal Atoms, by Irving L. Kofsky and Henry Levinstein. Physical Review 74, p. 500, August 15, 1948.

A new, rapid, and readily adaptable method for the determination of the velocity distribution of thermal atoms is suggested. The authors used a Langmuir-Taylor hot-wire detector and applied the time-dependent current to a cathode ray oscilloscope with a linear sweep. It is suggested that improvements in the method may make possible the determination of the relaxation time, or the mean time an atom stays on the hot wire.

1023 Fluctuations of Ionization and Low Energy Beta-Spectra, by D. H. W. Kirkwood, B. Pontecorvo, and G. C. Hanna. Physical Review 74, p. 497-498, August 15, 1948.

The isotope, A^{37}, which decays by K-capture without emission of a positron, was introduced inside various proportional counters filled with an argon-methane mixture. A typical differential curve is shown (noise = 4500 pairs of ions, multiplication = 10^4). The main peak corresponded to about 2800 ev., the K electron binding energy in the Cl^{37} atom. The low energy peak is about 200 ev., the ionization energy of the L shell. Mechanisms for the peaks are postulated, and it is concluded that the proportional counter at high multiplication factor may be used not only in beta-ray problems but also in X-ray applications.

PHYSICS, GENERAL

1024 Increase in Vapor Pressure of Liquid Helium Due to He^3 in Solution, by Henry A. Fairbank, Charles A. Reynolds, C. T. Lane, B. B. McInteer, L. T. Aldrich, and Alfred O. Nier. Physical Review 74, p. 345-346, August 1, 1948.

With a thermal diffusion column the authors recently produced about 100 standard cm^3 of helium gas containing approximately 0.16 percent He^3. An attempt was made to measure differences in the vapor pressure between this gas enriched in He^3 and normal well-helium, the latter being practically pure He^4. The He^3-enriched material showed a higher vapor pressure than the He^4 at all temperatures.

1025 On the Field of an Electron, by G. Petiau. Revue Scientifique 85, p. 916, September 1 and 15, 1947, (In French).

A radius of $\sim 12e^2/mc^2$ can be defined for an electron by equating its mass with the energy of its magnetic field instead of the usual electric field. For neutron and proton similar radii can be defined.

1026 Theory of Elliptically Polarized Photons, by Gentaro Araki. Physical Review 74, p. 472-479, August 15, 1948.

The unitary transformation from linearly to elliptically polarized states of photons is determined in a scheme of the second quantization. It is given by $e_l = e_1 \cos \phi + ie_2 \sin \phi, e_r = ie_1 \sin \phi + e_2 \cos \phi$ where e_1 and e_2 are orthogonal unit vectors corresponding to linearly polarized states of photons and e_l and e_r are those corresponding to left and right elliptically polarized states of photons. A general formula for a probability of an emission of light from an atom is deduced on the basis of the Dirac electron theory so as to include up to both a magnetic dipole and an electric quadrupole term. Its general form is improved as compared with the hitherto obtained one. The general theory is applied to electric dipole and quadrupole and magnetic dipole spectral lines. Polarization states of the Zeeman components corresponding to all combinations of magnetic and orbital magnetic quantum numbers of an atom are completely determined for an arbitrary given direction of an observation on the basis of quantum mechanics.

RADIATION SICKNESS

1027 On Irradiation Sickness, by K. Setala and P. Ermala. Annales Chirurgiae et Gynaecologiae Fenniae 37, Suppl. 1, p. 1-60, 1948. (In English).

RADIOACTIVITY

1028 **Experiments on the Effect of Atomic Electrons on the Decay Constant of Be^7, by E. Segre and C. E. Wiegand. AECD-2199 (UCRL-137), June 22, 1948, decl. August 6, 1948. 15 p. For publication in a technical journal.**

The decay constant of a radioactive substance undergoing orbital electron capture is proportional, according to current beta decay theories, to the electron density at the nucleus. This fact seems to afford a possibility of altering the nuclear decay constant by acting on the atomic electrons; if it were possible to completely strip a nucleus of all its electrons, it clearly could not decay by orbital electron capture and such a radioactive nucleus, as long as it stays stripped, should be stable. In an attempt to detect a possible influence of the atomic electrons on the radioactive decay constant of Be^7, $\lambda_{Be} - \lambda_{BeC}$ was measured and found to be $(-3.0 \pm 1.8)\ 10^{-4}\ \lambda_{Be}$. It is not known whether this extremely small change in λ, the radioactive decay constant, is caused by an accidental compensation of various effects or whether it can be ascribed to other causes. A method is also described for measuring the mean lives of radioactive substances in a time which is short compared with the mean life.

1029 **The Beta- and Gamma-Spectra of Gallium Irradiated by Slow Neutrons, by S. K. Haynes. Physical Review 74, p. 423-432, August 15, 1948. (Summary of various MDDCs).**

The beta and gamma-ray spectra of gallium irradiated with slow neutrons have been investigated with a thin magnetic-lens spectrometer. Probable beta-ray end points for Ga^{72} at 3.15 Mev (9.5 percent), 2.52 Mev (8 percent), 1.48 Mev (10.5 percent), 0.955 Mev (32 percent), and 0.64 Mev (40 percent) were found. A conversion line occurring in about 0.5 percent of the disintegrations was observed at 0.68 Mev. Gamma-rays of 2.51 Mev (26.5 percent), 2.21 Mev (33 percent), 1.87 Mev (7.8 percent), 1.59 Mev (4.5 percent), 1.05 Mev (4.5 percent), 0.84 Mev (100 percent), and 0.63 Mev (24 percent) were also found for Ga^{72}. A nearly complete decay scheme for Ga^{72} is suggested. The beta-ray spectrum of Ga^{70} (20.5 min.) has also been observed with the spectrometer. The Kurie plot is linear from the end point of 1.65 Mev to 0.4 Mev. No evidence of conversion lines in this energy interval was found. 23 references.

1030 **The Disintegration of Cs^{137}, by J. Townsend, Marshall Cleland, and A. L. Hughes. Physical Review 74, p. 499, August 15, 1948.**

The X rays emitted from Cs were found to be characteristic of Ba, indicating that the excited Ba nuclei, following the beta decay of Cs, emit the gamma rays. The life of the Ba^{137} excited state was investigated, the decay was plotted, and the half life was found to be 158 ± 5 sec. A simple decay scheme is proposed. It is suggested that the Cs^{137} spin may be directly measured by the atomic beam method used by Zacharias (Physical Review 60, p. 168, 1941).

RADIOACTIVITY

1031 Long-Lived Tc Activities Produced by Deuteron Bombardment of Separated Mo Isotopes, by E. E. Motta and G. E. Boyd. Physical Review 74, p. 344-345, August 1, 1948. (See also AECD-2074).

The material discussed in this article was based on AECD-2074 and has been abstracted in v. 1, of this journal as Abstract No. 300.

1032 The Natural Radioelements (Les Radioelements Naturels), by Irene Joliet-Curie. Paris, Hermann, 1946. 191 p.

The properties and methods of extraction and purification of the naturally occurring radioelements, as well as methods of determination are given. Two chapters are devoted to methods of radiochemistry and its applications. An outline of our knowledge of artificial radioelements is included.

1033 Notes on the Beta-Ray Spectra from Copper 64, by W. E. Meyerhof and M. Goldhaber. Physical Review 74, p. 348-349, August 1, 1948.

In the investigation of beta-ray spectra one may meet with two possible sources of extraneous electrons: homogeneous internal conversion electrons, which are usually easily recognized as such, and electrons from internal pair production, which have a continuous distribution in energy. The authors looked for pairs from Cu^{64} in a pair spectrometer of approximately 10 percent resolution for total pair energy. The total pair energy range covered was 100 to 400 Kev. The results show that in this range the number of pairs, if they exist, must be less than 0.2 percent of the total number of transitions.

Internal conversion electrons of the 1.35 Mev gamma ray were looked for, using a conventional 180° type magnetic spectrometer of approximately 5 percent resolution. An electron range of 1.15 to 1.55 Mev was covered. According to results the internal conversion coefficient of the 1.35 Mev gamma ray must be less than 5.10^{-3}. A decay scheme for Cu^{64} is given.

1034 Radiations from Mg^{27} and Al^{28}, by J. Benes, A. Hedgran, and N. Hole. Arkiv för Matematik, Astronomi och Fysik 35A, Paper 12, 1948. 8p.

The β- and γ-radiations emitted by Mg^{27} and Al^{28}, formed respectively by fast and slow neutron bombardment of Al^{27}, were studied with a magnetic lens spectrograph. The γ-rays were studied by observing the Compton- and photoelectrons ejected from a Cu-Pb radiator. For Mg^{27} the γ-γ coincidences were also investigated. Term-schemes are proposed for both disintegrations.

RADIOACTIVITY

1035 Shape of the Positron Spectrum of N^{13}, by C. S. Cook, L. M. Langer, H. C. Price, Jr., and M. B. Sampson. Physical Review 74, p. 502-503, August 15, 1948.

Samples of N^{13} were produced by $C^{12}(d,n)$ in the cyclotron and the decay curve of the positron activity taken over five half-lives in the spectrometer at an H = 2487 gauss-cm. A simple decay with a half-life of 10.2±0.1 min. was shown. The Fermi plot of the momentum distribution is given, and the data are fitted by a theoretical straight line down to $W = 1.3\ mc^2$. A straight line extrapolation yields an end point value for N^{13} of $E_o = 1.25 \pm 0.03$ Mev.

RADIOCHEMISTRY

1036 Effect of High-Voltage X-rays and Cathode Rays on Vitamins (Niacin), by Bernard E. Proctor and Samuel A. Goldblith. Nucleonics 3, No. 2, p. 32-43, August 1948.

Niacin in solutions, ranging from concentrations of 100 micrograms per ml to 5 micrograms per ml, was irradiated by X rays and cathode rays produced at 3 megavolts. It was irradiated also in the presence of methionine and ascorbic acid. The degree of retention of niacin in solution was determined photometrically in a Cenco Photelometer by a modification of the Mueller and Fox cyanogen bromide and ammonium hydroxide method.

It was shown that X rays in total dosages of 125,000 to 850,000 r did not destroy niacin in concentrations of 100 micrograms per ml, whereas cathode rays destroyed as much as 49 per cent with the short period of 15 sec. at 10 microamperes. The effect produced by a given total dosage of X rays was independent of the rate of dosage up to at least 5 times the initial rate. At concentrations of 50 micrograms per ml there was partial destruction (14 per cent) following X-ray dosages of between 50,000 and 100,000 r and the percentage of destruction increased up to 250,000 r, when it decreased percentagewise until it reached a constant level between 750,000 and 1,000,000 r. The same effect was noted when cathode rays were used on diluted solutions. This seemed to indicate that the destruction of the niacin is the result of indirect action of the radiations on the solvent rather then of destruction of the niacin by "hits."

In the presence of methionine the niacin loss following X-ray treatment was slightly greater than when niacin was treated alone. The opposite was found following radiation by cathode rays. And although ascorbic acid was more radiosensitive alone than niacin, in the presence of niacin it was less sensitive and as little as 10 micrograms per ml of niacin protected 500 micrograms per ml from hard X rays. A change was caused in the ultraviolet absorption spectrum following cathode irradiation. 10 tables; 30 references.

1037 The Radiochemistry of Aqueous Solutions; a Survey of Recent French Research, by M. Frilley. British Journal of Radiology, Supplement No. 1, 1947 (Certain Aspects of the Action of Radiation on Living Cells) p. 50-55.

Work performed on the production of H_2O_2 by irradiation of water is reviewed. The H_2O_2 yield is the same for both X-rays and α-rays. The role of dissolved oxygen in the production of H_2O_2 by irradiation of water is described. The H_2O_2 yield is increased in the presence of hydroquinone, crysteine ascorbic acid, and aldehydes; organic acids, however, diminish the yield of H_2O_2. pH changes and the mechanism of the action of ionizing radiations on aqueous solutions are considered briefly.

RADIOTHERAPY

1038 The Effect of Urethane on the Nuclear Morphology of Cells of the Granulocyte Series as Observed in Marrow Cultures and Leukemic Blood, by Edwin E. Osgood and I. T. Chu. Blood, the Journal of Hematology 3, p. 911-917, August 1948.

Using the technic of human marrow culture a study was made of the morphologic changes in cells of the granulocyte series produced by the action of urethane. It is concluded that either radioactive phosphorus or total body irradiations with X-rays given in small regularly spaced doses is far superior to urethane in treatment of leukemias. When cells become resistant to radiation therapy, urethane may be worthy of a trial.

1039 Radioactive Iodine. Journal of the American Medical Association 137, p. 1499, August 14, 1948.

A letter to the editor asks about the status of radioactive iodine in treating toxic goiter. The editor's reply is reproduced below:

There are still not enough observations to say definitely what the status of radioactive iodine is in the treatment of toxic goiter. From data available it appears possible to produce a cure in a relatively large percentage of patients. If the correct amount of radioactive iodine is given, one dose is usually adequate. It has the advantage that it may be given by mouth. Thyroxin, which is the most important constituent of the thyroid hormone, contains 65 per cent of iodine by weight. When iodine is given in small quantities, it is taken up almost entirely by the thyroid, and if it is radioactive it destroys the thyroid cells. Patients who have received this form of treatment have not yet been followed long enough to determine whether there are any late complications, notably carcinoma. Expensive apparatus is necessary to follow the effect of radioactive iodine in an intelligent manner. Because of the expense involved and the uncertainty concerning complications of treatment, the use of radioactive iodine has been restricted to those patients who present poor operative risks. Propyl-thiouracil has been used for medical management in the same types of patients.

1040 Treatment of Euthyroid Cardiac Patients by Producing Myxedema with Radioactive Iodine, by Herrman L. Blumgart, A. Stone Freedberg, and Robert Buka. Proceedings of the Society for Experimental Biology and Medicine 67, p. 190-191, February 1948.

Radioactive I^{131} was administered to two severely ill cardiac patients who showed no clinical or laboratory evidences of thyrotoxicosis or myxedema. In both instances, decided reduction in the metabolic rate coincided with clinical improvement.

RARE EARTHS

1041 Mass Deposition of Completely Resolved Samarium Isotopes, by A. E: Shaw. AECD-2210, (ANL-AJD-251), July 8, 1948, decl. August 4, 1948. 2 p. For publication in Physical Review.

A continuation of the experiments with the new positive ion source (Physical Review 73, p. 1222, 1948), which employs a tungsten crucible surrounded by a tungsten loop filament for heating and ionizing the material within the crucible, has shown that it is suitable for producing microgram quantities of completely resolved isotopes. Electronic stabilizer circuits have been added to control both the electron bombarding voltage between the tungsten filament and the crucible, and the electron emission current from the filament to the crucible.

1042 Neutron Deficient Isotopes of Cerium and Lanthanum, by J. B. Chubbuck and I. Perlman. AECD-2218 (UCRL-141), June 28, 1948, decl. August 17, 1948. 7 p. For publication as a Letter to the Editor of Physical Review.

This report describes the results of some bombardments of Cs^{133} and La^{139} by deuterons and helium ions, performed with the 60-inch and 184-inch cyclotrons at Berkeley. These bombardments resulted in the production of the following isotopes: 19.5 hour La^{135}, which decays by orbital electron capture and emits gamma radiation of 0.76 Mev energy; 2.1 hour La^{136}, which decays by positron emission, the positron having 0.84 Mev energy; La^{137}, which has a half-life greater than 400 years; 16 hour Ce^{135}, which decays by positron emission; 36 hour Ce^{137}, which decays by orbital electron capture emitting conversion electrons of 0.18 Mev energy and gamma radiation of 0.28 and 0.75 Mev energies; and 140 day Ce^{139}, which decays by orbital electron capture emitting conversion electrons of 0.15 Mev energy and gamma radiation of 0.18 and 1.8 Mev energies. The results are summarized in a table.

1043 Coincidences between Beta-Rays and Conversion Electrons in Europium, by K. Y. Chu and M. L. Wiedenbeck. Physical Review 74, p. 494, August 15, 1948.

The beta-conversion electron coincidence rate for europium was measured as a function of absorber thickness. The maximum value for the energy of the conversion electrons is about 375 Kev. The conversion coefficient of the gamma rays following the lower energy beta-component is 35 per cent.

1044 Concerning the Existence and Stability of the Crystalline Hydroxides of the Rare Earths, by August Seitz. Zeitschrift für Naturforschung 1, p. 321, June 1946.

This paper presents evidence of the existence and stability of the crystalline hydroxides of the rare earths.

RARE EARTHS

1045 A Proposal of the Name Prometheum for Element 61, by J. A. Marinsky and L. E. Glendenin. Chemical and Engineering News 26, p. 2346-2348, August 9, 1948.

The authors assert they were the first to give definite evidence of the existence of an isotope of element 61, and, if earlier claims to such discovery are refuted, they seek the right to name the element. Prometheum is their choice.

SPECTROSCOPY

1046 Comparative Study of Various Methods of β-Ray Spectroscopy, by M. P. Hubert, Journal des Recherches du Centre National de la Recherche Scientifique No. 3, p. 165-175, 1947. (In French).

The results of the above study in the field of spectroscopy and electron optics are presented. The theory and calculation of spectrographs made by semicircular deflections, the theory of longitudinal magnetic field spectrographs, and spectrographs with magnetic lenses are considered. A description of various types of apparatus together with results obtained from their use are included. 13 references.

1047 An Investigation of Spectrochemical Sparking-off Effects in the Flat Surface Sparking of Steels, by D. M. de Waal, and A. Strasheim. Spectrochimica Acta 3, p. 141-157, 1948.

An investigation of sparking-off effects obtained with flat surface sparking of steel samples has led to the adoption of a short spark gap (1.5 mm) and a blunt graphite electrode to limit the length of the spark. This improvement does not eliminate the drift of working curves. Analysis of sparking-off effects has pointed to the large effect of oxidation and the role of water vapor in the spark atmosphere It is suggested that variable atmospheric humidity may be one major cause of curve drift.

1048 Multiplet Separations in Complex Spectra, Part II, by V. Ramakrishna Rao and K. R. Rao. Indian Journal of Physics 22, p. 189-194, April 1948.

Expressions derived by Goudsmit and Hymphreys (Physical Review 31, p. 960, 1928), for multiplet separations in complex spectra, have been applied to the observed multiplets of d^3s and d^3p configurations in Zr I, Cb II, and Ti I, V II and Cr III. A comparison between the theoretical and the experimental values of the separation factors indicated agreement in the deeper terms and chiefly of the d^3s configuration. The methods is expected to give only the order of magnitude of the separations when it is used for the purpose of predicting unknown structures.

SPECTROSCOPY

1049 The Photography of Fluorescence Spectra of Weak or Micro-Quantity Light Emitters, by Fred Scheminzky. Spectrochimica Acta 3, p. 191-204, 1948. (In German).

Fluorescence spectrography permits not only a qualitative determination of uranium present in small quantities in waters of different origin or in minerals, but also a quantitative determination of uranium through photometry of the spectra. The occasional weak fluorescence or the frequently occurring minuteness of the specimens result in inconveniently long exposures with the usual spectrographs. Consequently, the author describes the construction of a miniature spectrograph which he had previously developed for use with a Contax camera and hand spectroscope for the photography of fluorescence spectra. This instrument produces good photographic spectra with superimposed wave length scale with relatively short exposure times even in the case of samples smaller than one mm. The author discusses the manipulation of this instrument, describes exposure devices and gives suggestions for the choice of an objective, the most suitable emulsions, development procedure, and color photographs. In his discussion of the bands characterizing the fluorescence spectrum of uranium compounds, he points out that there is a band at about 663 mμ which has previously been overlooked on account of insufficient red sensitivity. Accordingly, the spectrum of U-NaF beads possesses seven bands.

1050 Sample Electrode Vapor Contamination of the Graphite Electrode in the Flat Surface Sparking Technique of Spectrochemical Analysis, by D. M. de Waal and S. M. Naude. Spectrochimica Acta 3, p. 127-140, 1948.

In the flat surface (point to plane) technique of spectrochemical analysis, some of the vapor released from the sample electrode during sparking is condensed on the graphite counter electrode. The counter electrode subsequently contributes to the radiation of the sample spectrum. The degree of contamination is dependent on the discharge-type and spark-gap parameters, but is in its turn responsible for effects with regard to the spectrum excitation which are characteristic of the method of flat surface sparking.

TRACER APPLICATIONS

1051 Advances in Biological and Medical Physics, Vol. 1, by John H. Lawrence and J. G. Hamilton. New York, Academic Press, 1948. 484 p.

The topics discussed are as follows: heavy and radioactive isotopes in clinical and experimental medicine; nitrogen and carbon isotopes, their application in vivo to the study of the animal organism; the nature and production of artificial radioactivity; fundamentals of radioactivity and its instrumentation; health physics instrumentation and radiation protection; the use of radioactive isotopes in the study of iron and hemoglobin metabolism and the physiology of the erythrocyte; radioactive phosphorus, its application to the study of phospholipid metabolism; iodine metabolism; the effects of the atomic bomb irradiation on the Japanese; and nucleic acid metabolism.

TRACER APPLICATIONS

1052 An Investigation of Transmethylation from N^1-Methylnicotinamide, by Elizabeth B. Keller, John L. Wood, and Vincent Du Vigneaud. Proceedings of the Society for Experimental Biology and Medicine 67, p. 182-184, February 1948.

N^1-methylnicotinamide labeled in the methyl group with deuterium was fed to two rats for 6 days. Analysis of the body choline and creatine of these rats for deuterium showed that there was no detectable transmethylation from N^1-methylnicotinamide to choline or creatine during this period.

1053 Use of Isotopes in Biology, by G. Popjak. Science Progress 36, p. 239-261, 1948.

This article is a review, it discusses the use of stable isotopes in studies of the metabolism of fats, cholesterol, amino acids and proteins, and of P^{32} in studies of the metabolism of phosphorus compounds. 49 references are given.

TRACER APPLICATIONS, RADIOACTIVE

1054 Distribution of Radioactive Carbon Administered as Carbonate in the Body and Excreta of Mature Rat, by W. D. Armstrong, Jack Schubert, and Arthur Lindenbaum. Proceedings of the Society for Experimental Biology and Medicine 68, p. 233-240, June 1948.

Radioactive carbon was administered to unfasted mature rats either by intraperitoneal injection of $Na_2C^{14}O_3$ or by implantation in the peritoneal cavity of $CaC^{14}O_3$. Quantitative studies were made of the relative amounts of C^{14} excreted in the urine, the feces, expired air and incorporated by the tissues and derived components. A significant incorporation of C^{14} was found in the inorganic carbonate fraction of bone and the bone protein, the dentin, and enamel of the teeth, fatty acids, glycerol, hemin, red cell protein, plasma proteins, central nervous system protein, liver and muscle glycogen, muscle protein, and in the proteins of the testes and of the thoracic and abdominal viscera.

1055 Incorporation In Vitro of Radioactive Carbon from Carboxyl-Labeled DL-Alanine and Glycine into Proteins of Normal and Malignant Rat Livers, by Paul C. Zamecnik, Ivan D. Frantz, Jr., Robert B. Loftfield, and Mary L. Stephenson. Journal of Biological Chemistry 175, p. 299-314, August 1948. (See also Nuclear Science Abstract No. 377).

The rate of incorporation of C^{14}-carboxyl-labeled DL-alanine into the proteins of rat liver slices was investigated. The rate of uptake of activity in surviving slices of hepatoma nodules was 7 times that of slices of normal livers and 2-1/2 times that of slices from the non-malignant portion of the hepatoma-containing livers. A preponderance of the activity incorporated was accounted for in the alanine fraction of the proteins. An increased rate of uptake of activity into hepatomas was likewise found when C^{14}-carboxyl-labeled glycine was used. It is concluded that, under the conditions used, the primary p-dimethylaminoazo-benzene-induced rat hepatoma incorporates more rapidly into protein than does normal resting adult rat liver.

TRACER APPLICATIONS, RADIOACTIVE

1056 Parrot Fish Thyroid Extract and Its Effect Upon Oxygen Consumption in the Fish, Bathystoma, by Dietrich C. Smith and Samuel A. Matthews. American Journal of Physiology 153, p. 215-221, May 1, 1948.

Extracts were prepared from the thyroid glands of Bermuda parrot fish, Radioactive I^{131} was injected into small parrot fish, the glands were removed and applied to unexposed X-ray plates. Such a procedure yielded autographs of the glands after several days of exposure. These extracts, when injected into white grunts weighing 15 grams or more, produced a significant rise in oxygen consumption within 24 hours after injection. Fish weighing less than 16 grams did not react by increasing their oxygen consumption.

1057 Radioiron in Ducks and Canaries and Its Effects on Their Initial Malarial Infections, by Paul E. Thompson, D. A. McGinty, D. L. Bush, and Mary L. Wilson. Journal of Infectious Diseases 83, p. 23-32, July-August 1948.

Radioactive colloidal iron mixtures (Fe^{55} and ^{59}) were administered parenterally in single and multiple doses to ducklings and canaries. These studies reveal the following: Radioactivity is evident in red cells 18 hours following single intravenous administration; during the next 70 hours, increasing amounts of radioactivity are found in blood cells with negligible amounts in plasma. Radioiron is utilized more rapidly by blood cells following intravenous injection than following intraperitoneal administration. Radioactivity of perfused tissues of ducklings receiving multiple doses of maximally tolerated amounts of radioiron over a period of 23 days was greatest in liver, bone marrow and spleen; lesser amounts occurred in other tissues studies. There was no evidence of intolerance to radioiron of specific activity of one millicurie per gram apart from the toxicity of iron itself.

The in vivo effects of radioiron on two species of malarial parasites were studied. Plasmodium cathemerium infections were established in canaries having 0.12 microcuries per ml blood. Plasmodium lophurae infections were initiated in ducklings have 0.10 microcurie per ml blood. There was no evidence of radiation damage to the plasmodia on the basis of their morphology and ability to produce an acute parasitemia. 19 references.

1058 Rapid Exchange of the Bone Salts in Newborn Rat as Demonstrated with Radioactive Phosphorus, by W. Percival, and C. Leblond. Revue Canadienne de Biologie 7, p. 217-227, 1948.

Small doses of radioactive phosphate were administered to newborn rats which were sacrificed at successive time intervals from 1 to 72 hours. The Geiger counter and autographic methods were used to study the distribution of radiophosphate in bones and teeth. All types of bone and teeth took up phosphate very rapidly suggesting that phosphate salts exchange readily, and that the bony structure is being renewed at a rapid rate in the newborn rat.

TRACER APPLICATIONS, RADIOACTIVE

1059 Radioactive Tracers for Determining Field Concentrations of DDT. Chemical Engineering 55, No. 8, p. 126, August 1948.

A method for the evaluation of insecticide dispersal in the field which makes it possible to detect 0.001 lb. of DDT per acre of ground has been developed. Radioactive manganese is dissolved in the DDT mixture and the latter is dispersed over the ground by spraying or other means. A Geiger counter is used to evaluate the distribution of the radioactive substance.

1060 Radio-Sodium Studies in Heart-Failure. Lancet 254, p. 527, April 3, 1948.

Experiments of several investigators on the use of radiosodium, Na^{22} and Na^{24}, in the study of chronic congestive heart failure are reviewed. As yet these studies have yielded no new concept of the disturbances in cardiac failure, though they suggest that the edema which forms part of the congestive failure complex is secondary to a disturbance in renal function rather than to some unbalance in capillary dynamics.

1061 The Tissue Distribution of Radioantimony Inhaled As Stibine, by Robert E. Smith, J. Murray Steele, Robert E. Eakin, and Dean B. Cowie. Journal of Laboratory and Clinical Medicine 33, p. 635-643, May 1948.

Radioactive antimony, administered as stibine gas (SbH_3) to chicks (both normal and infected with Plasmodium gallinaceum) and to normal guinea pigs, has been measured in the blood and tissues at successive time intervals following its administration. Significant differences were not apparent between distributions in normal and infected groups. The concentration of antimony in the blood stream exhibited a smoothly decaying curve, decreasing more rapidly in the guinea pig than in the chick. The red cells contained initially a much higher concentration of antimony than did the plasma, although this difference was reduced with time. The concentration curves of antimony in lung, brain, muscle, and fat were generally similar to those of blood, while those of the liver, and to a lesser extent of the spleen, passed through a maximum about one hour following treatment. Concentration curves of the kidney and heart were of variable shape.

Approximately four hours after treatment the tissue antimony levels became constant with respect to order of rank; levels in the liver, spleen, and kidneys were greater than in whole blood; all other tissues showed concentrations less than the blood but as much as or more than the plasma. Evidence is adduced to show that the rate of elimination from the body is higher for the guinea pig than for the chick.

1062 Turnover Rate of Phospholipid Phosphorus in the Liver of the White Rat, by Jesse L. Bollman, Eunice V. Flock, and Joseph Berkson. Proceedings of the Society for Experimental Biology and Medicine 67, p. 308-313, March 1948.

The purpose of the experiments reported here is to provide a quantitative estimate of the turnover rate of phospholipid phosphorus in the liver of the white rat under normal conditions of equilibrium, that is, while the actual concentration of the phospholipid phosphorus in the liver is not changing.

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TRACER APPLICATIONS, RADIOACTIVE

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P^{32} was used as a tracer. The proportional turnover rate for hepatic phospholipid in the white rat was found to be close to 5% per hour. In two series of experiments the mean concentration of hepatic phospholipid was 132 mg per 100 g of liver; thus, the mass turnover rate is about 6 mg P per hour per 100 g of liver, which is 0.2 mg P per 100 g body weight.

1063 The Urinary Excretion of Radioactive Iodine as an Aid in the Diagnosis of Hyperthyroidism, by Janet W. McArthur, Rulon W. Rawson, Rex G. Fluharty, and J. H. Means. Annals of Internal Medicine 29, p. 229-237, August 1948.

The use of radioactive isotopes of iodine has increased the ease and precision with which the urinary excretion of iodine can be determined in the "iodine tolerance test," which was designed to appraise the functional activity of the thyroid gland by measuring its ability to take up iodine. This test is useful in helping to make diagnoses of atypical forms of hyperthyroidism. It was shown in this work that the urinary excretion of radioactive iodine administered to 22 thyrotoxic patients ranged from 7 per cent to 45 per cent, while the range for 30 non-thyrotoxic patients was 23 per cent to 98 per cent. There is an appreciable overlapping between the 2 groups in the 20 to 40 per cent range that must be considered in making a diagnosis. 19 references.

TRANSURANIC ELEMENTS

1064 Chemistry of Element 93. Part 1. The First Isolation of Element 93 in Pure Compounds and the Half-Life Determination of Np^{237} by Direct Weighing, by L. B. Magnusson and T. J. LaChapelle. AECD-2179 (ANL-JJK-14B-1), n.d., decl. July 19, 1948. 15 p. For publication in NNES.

To establish the +4 and +6 oxidation states of neptunium, preparations on the ultra-microgram scale were made of neptunium dioxide, NpO_2, and sodium neptunyl acetate, $NaNpO_2(OOCCH_3)_3$. The formulas were confirmed and the crystal structures determined by X-ray diffraction. A more accurate specific activity and half-life for the long-lived alpha-emitting isotopes, Np^{237}, was obtained by the radiometric assay of pure samples of NpO_2. The specific activity of Np^{237} is 1520 disintegrations per minute per microgram and the half-life is 2.20×10^6 years. The values are estimated to be accurate to within 5 per cent. 10 references.

1065 The New Element Curium (Atomic Number 96), by Glenn T. Seaborg, Ralph A. James, and Albert Ghiorso. AECD-2182, January 1948, decl. July 30, 1948. 22 p. For publication in NNES.

Two isotopes of the element, atomic number 96, were produced by the helium-ion bombardment of Pu^{239}. These isotopes are: (1) 96^{242} which emits alpha particles with a range 4.75 ± 0.1 cm in air (energy 6.1 Mev) and decays with a half-life of 5.0 ± 0.1 months; and (2) 96^{240} which emits alpha particles with a range of 4.95 ± 0.1 cm in air (energy 6.3 Mev) and decays with a half-life of 26.8 ± 0.3 days. 96^{242} was also produced by neutron irradiation of Am^{241}. The mass assignments

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of these isotopes have been verified by isolation of their daughters, Pu^{238} and Pu^{236}. Some evidence for the isotope 96^{241}, decaying by orbital electron capture, is presented. The name curium (symbol Cm), is proposed for element 96. The chemical investigations of the heaviest elements indicate that the most stable oxidation state of curium is the III state. Several graphs of experimental data are included.

1066 The New Element Americium (Atomic Number 95), by Glenn T. Seaborg, Ralph A. James, and Leon O. Morgan. AECD-2185, January 1948, decl. July 30, 1948. 40 p. For publication in NNES.

Several isotopes of the new element 95 have been produced and their radiations characterized. The chemical properties of this tripositive element are similar to those of the typical tripositive lanthanide rare-earth elements. Element 95 is different from the latter in the degree and rate of formation of certain compounds of the complex ion type. This difference makes possible the separation of element 95 from the lanthanide rare earths.

The name americium (after the Americas) and the symbol Am are suggested for the element on the basis of its position as the sixth member of an actinide rare-earth series, analogous to europium, Eu, of the lanthanide series.

The isotopes found and studied in this work are: (1) Am^{241}, which decays by the emission of alpha particles (energy 5.45 Mev) with a 510±20-year half-life. It is produced by the beta-decay of Pu^{241}, which, in turn, is produced by the (α,n) reaction on U^{238}; (2) Am^{242}, which decays by the emission of beta particles (ca 0.8 Mev maximum energy) with a 17-hour half-life or, in another isomeric form, by branching decay with the emission of alpha particles (energy unknown) and beta particles (ca 0.5 Mev maximum energy) in the ratio ca 0.002 alpha particles per beta particle: both isomers are produced by neutron capture in Am^{241}; (3) Am^{239}, which undergoes branching decay, decaying (a) by orbital electron capture with a 12-hour half-life and emitting 0.285 Mev gamma rays and conversion electrons in addition to the characteristic X-rays and (b) by alpha-particle emission (energy unknown) in the ratio ca 0.001 alpha particles per electron capture. This isotope is produced by the (d,2n) reaction on Pu^{239} and by the $(\alpha,2n)$ reaction on Np^{237}; (4) Am^{238}, which decays by orbital electron capture with a 50-hour half-life emitting 1.3-1.4 Mev gamma rays and conversion electrons in addition to the characteristic X rays. Am^{238} is produced by the (d,3n) reaction on Pu^{239} and by the $(\alpha,3n)$ reaction on Np^{237}. Graphs of experimental data are included. 16 references.

1067 The Crystal Structure of PuN and PuC, by W. H. Zachariasen. AECD-2195 (ANL-JJK-14B-9), n.d., decl. August 2, 1948. 4 p. For publication in NNES.

This paper describes the determination of the crystal structure of PuN and PuC. The work was carried out using plutonium preparations of unknown composition. Hence, the presence of the compounds PuN and PuC in the preparations was deduced from the X-ray diffraction examination. PuN and PuC have the NaCl-type of structure. The lattice constants and calculated densities are:

PuN	$a = 4.895 \pm 0.001$A	$\rho = 14.23 \pm 0.01$
PuC	$a = 4.910 \pm 0.005$A	$\rho = 13.99 \pm 0.05$

TRANSURANIC ELEMENTS

1068 Isotopes of the New Element, Curium (Atomic Number 96), by Ralph Arthur James. AECD-2224 (UCRL-99), n.d., decl. August 15, 1948. 32 p. For use as thesis.

Three isotopes of the element whose atomic number is 96 were produced by the helium ion bombardment of plutonium. Element 96 has been given the name curium and the symbol Cm because of its similarity to gadolinium, the analogous element in the lanthanide series. The tracer chemistry of curium has been studied and has revealed only a very stable (III) oxidation state. The isotopes of curium which were produced and studied are: (1) Cm^{242}, which emits alpha particles with a range of 4.75 ± 0.1 cm in air (energy 6.1 Mev) and decays with a half-life of 5.0 ± 0.1 months, (2) Cm^{240}, which emits alpha particles with a range of 4.95 ± 0.1 cm in air (energy 6.3 Mev) and decays with a half-life of 26.8 ± 0.3 days, and (3) Cm^{241}, which decays by orbital electron capture with a half-life of 55 ± 15 days. 12 references.

1069 The Extension of the Periodic System Through the Trans-Uranium Elements, by K. Starke. Naturwissenschaften 34, No. 3, p. 69-75, 1947. (In German).

Recent developments are reviewed. 4 tables and 66 references are included.

URANIUM

1070 The Use of Aluminum Chloride in the Determination of the Total Uranium Content of Uranium Tetrafluoride, by S. H. Anonsen and C. L. French. AECD - 2169, July 1946, decl. July 23, 1948. 3 p. For publication in NNES.

It was desirable to find a method for dissolving uranium tetrafluoride easily without the use of boric acid since many other samples are analyzed for trace amounts of boron in the same laboratory and therefore the possibility of contamination is always present. The following analytical procedure (condensed form) with aluminum chloride substituted for boric acid was studied and the validity tested satisfactorily: about 0.5 g sample of UF_4 is dissolved in 1 g $AlCl_3.6H_2O$ and 50 ml 4 N HCl. Three ml of 1:1 H_2SO_4 is added and the solution first evaporated to 10 ml and then diluted to 75 ml with H_2O. The resulting solution is drawn through a Jones reductor. Thirty ml H_2SO_4 and 3 ml H_3PO_4 and 3 ml H_3PO_4 are added and the solution titrated to a green end point with 0.08 N $Ce(SO_4)_2$ in the presence of o-phenanthroline θ ferrous complex indicator.

1071 The Synthesis of U_2F_9, by Ralph Livingston. AECD-2177, n.d., decl. July 28, 1948. 1 p. For publication in Journal of the American Chemical Society and for publication in NNES.

This is not an abstract; the text of the document is reproduced below in its entirety. In the study of radiation effects on UF_6 it became desirable to synthesize UF_5, as well as other compounds, for X-ray diffraction studies. The UF_5 synthesis was attempted by the reaction of dry-process (monoclinic) UF_4 with UF_6. Several runs were made, and in each case a black product was formed. Samples were submitted to W. H. Zachariasen for diffraction studies, and he found that the material was cubic and could not contain as many as five fluorine atoms per uranium atom. Moreover,

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the material on standing a few weeks formed a green product which was shown by Zachariasen to be identical with the starting UF_4.

A typical synthesis of the black fluoride was carried out by placing 15.5 g dry-process UF_4 in a monel metal cell, evacuating and baking at 100°C for 20 hours and then condensing 16.5 g UF_6 in the cell. The mixture was heated to 125°C for 2 1/2 hours, followed by the removal of excess UF_6 by pumping for several hours at 100-110°C.

A supply of this substance was sent to the S.A.M. Laboratory at Columbia University. This group continued the study. Weller, Grenall, and Kunin showed the correct formula to be U_2F_9.

W. H. Zachariasen has recently reported on the crystal structure work on the black U_2F_9 described above (Journal of Chemical Physics 16, p. 425, 1948).

1072 The Crystal Structure of Uranium Hexa-Chloride, by W. H. Zachariasen. AECD-2184 (ANL-4107), January 27, 1948, decl. July 19, 1948. 6 p. For publication in a technical journal.

UCl_6 is hexagonal with three molecules per unit cell and lattice dimensions $a_1 = 10.95 \pm 0.02$ A and $a_3 = 6.03 \pm 0.01$ A. By means of X-ray diffraction data obtained from a micro-preparation of UCl_6, the complete structure was determined and found to be of molecular type containing octahedral UCl_6 molecules with U-Cl = 2.59 A. The closest distance between chlorine atoms belonging to different molecules is Cl-Cl = 3.65 A.

1073 Organic Solvates of Uranyl Nitrate, by Leonard I. Katzin. AECD-2213 (ANL-HDY-212), n.d., decl. August 17, 1948. 4 p. For publication as a letter in Journal of the American Chemical Society.

Studies were made with several organic liquids in which uranyl nitrate is highly soluble for the purpose of identifying the solvates. Uranyl nitrate trihydrate was used as the starting salt. Concentrated solutions of the salt were made and the solvates crystallized out of solution. Formulas for the crystals were then determined. However, it was thought probable that for each solvent a whole range of pure and mixed solvates may be formed. The organic solvents used were diethyl ether, diethyl "cellosolve," diethyl "carbitol," dibutyl "carbitol," acetone, methyl propyl ketone, hexone, diisopropyl ketone, ethyl acetate, ethyl propionate, and isobutyl alcohol.

1074 Titration Studies of Complex Ions of Uranium and Organic Anions, by Jean Rodgers and William F. Neuman. AECD-2216 (M-1991), September 1947, decl. August 11, 1948. 14 p. For publication in Journal of the American Chemical Society and NNES.

Because of its importance in uranium toxicology, a program was undertaken to study the behavior and characteristics of the uranium-citrate complex. Titration data of complexes of citrate and of

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other homologous anions with uranyl ion are reported. A consideration of the data obtained has led to the tentative assignment of a structural formula for the uranyl-citrate complex.

1075 Crystal Structure of Uranium Oxide (U_3O_8), by Fredrik Gronvold. Nature 162, p. 70, July 10, 1948.

Single U_3O_8 crystals could not be prepared; however one preparation gave X-ray photographs in which reflections with indices 001 only were sharp and well defined. From this a hypothetical crystal structure was formulated. The cell is orthorhombic with dimensions a = 6.703 kX; b = 3.969 kX; c = 4.136 kX. The density of U_3O_8 is 8.34 g/c.c. The elementary cell contains two uranium atoms. The U_3O_8 structure is probably related to the ReO_3 structure, but with deformed UO_6^{-4} octahedrons with anion vacancies.

1076 The Magnetic Susceptibility of Uranium Tetrafluoride, UF_4, by Norman Elliott. Physical Review 74, p. 498-499, August 15, 1948.

The magnetic susceptibility of UF_4 has been measured between 74.5°K and 294.5°K using a Bouy balance, the salt being in the form of a powder. The results are plotted and seem to obey the Weiss-Curie law. Using $\chi = C/(T + \Delta)$, Δ is 146°K, and C = 1.00. Using $\mu = 2.83(\chi_m (T + \Delta))^{1/2}$, the magnetic moment of the U^{4+} ion is found to be 2.83 Bohr magnetons. The experimental data lead to the conclusion that the crystalline field has broken down the spin-orbit coupling and that a non-magnetic state lies considerably below all other states.

1077 A New Method for the Colorimetric Estimation of Traces of Uranium, by Amar Nath Majumdar. Science and Culture 13, p. 468-469, May 1948.

The author has devised a method which is accurate to within $\pm$ 3 per cent. It was found that in the absence of interfering ions and soluble carbonates, UO_2^{++} gives a blue colored lake with an alcoholic solution of quinalizarine at a pH of approximately 7.2. The region of maximum absorption was determined from the plot of the percentage transmittancy with filters of varying wave lengths in a photoelectric colorimeter. The maximum absorption was found in the region of 575 mμ. At this pH (7.2) the blank has a light violet color; the region of maximum absorption for the blank was found to be at 515 mμ. From the transmittancy curves of the two (blank and uranium lake) it was found that the filter 620 mμ was the most suitable; at this region the absorption of the blank was quite negligible while that of uranium lake was very near the maximum. The percentage transmittancies of a series of standard uranium solutions of varying strengths with quinalizarine were determined in a photo-electric colorimeter using a 620 mμ filter. The plot of the log transmittancy against concentration was found to be a straight line when the concentration was within the range of 3 to 10 ppm of uranium (3γ to 10γ of uranium per cc). Thus Beer's Law holds good within this region and this method can be used for the colorimetric estimation or uranium.

VACUUM

1078 Vacuum Gauges, by Kenneth Simpson. AECD-2186 (BP-34), n.d., decl. August 2, 1948. 61 p. For publication in NNES.

This report is a survey of vacuum gages under the following six classes: (1) hydrostatic pressure gages, (2) thermal conductivity gages, (3) viscosity gages, (4) gages depending on the radiometer effect, (5) ionization gages, and (6) discharge tubes. Theoretical considerations, principles of design, and operating characteristics are discussed. Several figures are included. 62 references.

1079 Miscellaneous Vacuum Materials and Equipment, by William E. Bush. AECD-2206 (BP-68), n.d., decl. August 11, 1948. 65 p. For publication in NNES

This document outlines certain requirements and specifications necessary in the design of vacuum processing equipment and reviews current design practice. Several drawings are attached. 42 references.